A

TREATISE

ON THE

PRACTICE

OF

FIELD ARTILLERY.

COMPOSED FOR THE USE

OF THE

R. E. V. ARTILLERY.

EDINBURGH:

PRINTED IN THE YEAR

1799.

ADVERTISEMENT.

THE contents of the following Sheets were written by Major MACDONALD, at the requeſt of the Gentlemen of the R. E. V. Artillery Company, and are now printed for their uſe. Major MACDONALD, when he commanded the Company, paid much attention to the Minutiæ of the Dragrope Exerciſe; and having, before he exchanged that command for his Majority in the Regiment of the Iſles, nearly completed the Manuſcript of this Pamphlet, it has been ſince finiſhed, and preſented by him to the Company.

THE chief object in view is to have the detail of the Dragrope Exerciſe made familiar to every individual, even to thoſe whoſe particular avocations prevent a very regular attendance at Drill; but to theſe details there has alſo been added ſome Miſcellaneous Matter, which, it is hoped, may, in ſome meaſure, induce the Gentlemen of the Company to beſtow ſome ſtudy on the Theory as well as the Practice of Gunnery.

ERRATA.

Page 7 line 16 *for* ſyſtem *read* ſyſtems
—— 7 —— 23 *for* 9 fires and tubes, *read* 9 fires
—— 20 —— penult. *for* follow *read* follows
—— 38 —— 1 *for* of *read* off
—— 61 —— 21 *for* e c *read* c
—— 83 —— 8 *for* ſtick *read* ſticks

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N. B.—As this Treatise is not intended for General Publication, a limited Number of Copies has been printed.

THE ARTILLERY MANUAL.

PART I.

See PLATE I. Fig. 1.

DRAGROPE EXERCISE, having 21 MEN to a GUN.

THE exerciſe was adapted to this number, which the corps could afford each gun.

1, 2, 3,—4, 5, 6,—7, 8, 9, and 10, 11, 12, carry, each three, a dragrope. 13 loads. 14 ſpunges. 15 portfires. 16 ſerves the vent. 17 and 18 (two non-commiſſioned officers) ſteer, truck and direct. 19 carries a bucket, ſlow-match, and a ſpare portfire and portfire-ſtick. 20 carries the cartridges to 13 from 21, who carries a cartouch box, and attends the limber and horſes.

ORDER OF MARCH.

"Dragrope men, Right about face." "Right and left inwards wheel." "Front."—16, 18, 19 and 15, 17 and 20, are arranged, at equal diſtances, between the head of the

horſe and the front of the dragrope men, who march in common file. 21 marches before the horſe.

To Unlimber.

21 unchains. 17 and 18 raiſe the trail of the carriage. 19, 20 and 21 remove the limber. 9 and 12, and 3 and 6, take off the tarpauling. 8 and 11 take off one, and 2 and 5 the other ſide box; place them on the limbers, and ſecure them there. 13, 14, 15 and 16, unlaſh the ſide arms. 1, 4, 7 and 10, get ready their dragropes, and the whole will fall into poſition for action, as *per* figure *. When an attack is expected, the ſide arms are not laſhed, and 14, 15, 16, 19, 20 and 21, muſt, with the dragrope men, be ready prepared for action. When the gun is relimbered, theſe different duties will be executed by the ſame numbers, replacing the ſide boxes, ſide arms, tarpaulings, limber chain and trail in their original poſition.

N. B. If the gun has its full complement of horſes, the men are arranged at wide intervals.

* No. 20, though placed in theſe figures behind 17 and 18, is in general, both in action poſition and the different movements, placed exactly oppoſite to 19.

To Advance Quick or Slow from Action Position.

"Prepare to advance." 5 and 8 ſlip under the ropes, and 6 and 9 round the loop ends. 4 and 7 hook to the breaſt eye-bolts. 1 and 10 hook to the drag waſhers, while 2, 3, 5, 6, 8, 9, 11 and 12, take the centre and front pins, repreſented by dots in the figure. "Quick (or ſlow) "march." The whole move forward, with the left foot commencing the ſtep. "Halt. Prepare for action." The foot raiſed is planted, completing its ſtep by bringing up the other to it. 5 and 8 ſlip under, from the in to the outſides of the ropes. 6 and 9 go round the loop ends.

4,

4, 7, 1 and 10, unhook, while 2, 3, 5, 6, 8, 9, 11 and 12, wheel, rapidly, to the right and left, outwards, into position for action. N. B. In going round the loop end of a rope, the front is always held to the rope and loop, and the hands change places on the rope; for instance, 6 goes round the loop end, facing to the rear. In going round, the hands approach each other, the right occupying the point of the rope originally held by the left. In this position, with the front pin in his right hand, he is, instantly, ready to wheel backwards, or rather laterally, into advancing position. Going round the loop or hook ends, precisely, is to be well attended to; the perfection of the exercise depending much on the neatness of execution of this movement. On the opposite side of the gun, the reverse of the above movement of No. 6 takes place, by 9.

To Retreat Quick (or Slow) from Action Position.

"Prepare to retreat." The whole go to the right about. In this movement, the dragrope men raise the ropes over their heads, approach the hands to each other, and bring down the ropes with the right, where the left was situated previous to coming about. All will move rapidly to retreating position, (as *per* figure), 7 and 4, 10 and 1, hooking to the drag-washers and trail-staples. "Slow march." "Halt. Prepare for action." 4, 7, 1 and 10, unhook, and slip round the hook ends. 6, 9, 3 and 12, slip round the loop ends. 5, 8, 2 and 11, slip under the ropes, changing from out to inside, when the whole wheel, rapidly, to the right and left, outwards, into action position. When the guns are not in action retreating, at the word "Prepare to retreat," 19, 20 and 21, will move to the right and left, taking post behind 13 and 14. In firing retreating, 1, 2, 3, 10, 11 and 12, retreat the gun; and 4, 5, 6, 7, 8, 9, retire to

the

the limber. In firing advancing, 1, 2 and 3, 10, 11 and 12, will hook on to the trail to check, if neceſſary, while 4, 5 and 6, 7, 8 and 9, advance the gun.

(From advancing poſition). "Prepare to retreat." 1 and 10, 4 and 7 unhook, and ſlip round the hook ends. 3 and 12 go round the loop ends. 2 and 11 change from out to inſide of the ropes. The whole will wheel, or rather move, rapidly, over the leaſt poſſible ſpace of ground, to the rear, 1 and 10 hooking to the trail-ſtaples, and 4 and 7 to the drag-waſhers. (From retreating poſition). "Prepare to advance." Reverſe the laſt movement to effect this.

Ditch Exercise.

"Prepare to lower the gun into the ditch, advancing."

See plate I. fig. 2.

All being in advancing poſition, as *per* fig. 1. 2 and 11 ſlip under the ropes, and 3 and 12 round the loop ends. 1 and 10 unhook from the drag-waſhers, ſlip round the hook ends, and (aſſiſted by 14 and 13) faſten their ropes round the naves of the wheels, the hook being in contact with, and held on the rope, by the rear pin. 7 and 4 hook to the drag-waſhers, 5 and 8 changing under, and 9 and 6 going round the loop ends. All being ſituated as *per* fig. 2. the front ropes gently lower the gun into the ditch, while the rear ones prevent, by holding on a proportioned ſtrain check, an over rapid deſcent. 17 and 18 will untruck in this caſe. In hooking to the nave, the hook is not brought in contact with the nave at the hooking point, as the rope would coil round it in the gun's deſcent, and thus be ſhortened and rendered uſeleſs. The men are ſtationed on the outſide of the nave ropes, to prevent being confined in their action by the checks, if on the inſide; and 4, 5, 6, 7, 8 and

9,

9, are on the outſide, to be out of the way of the gun, ſhould it, by careleſſneſs or accident, ruſh forward. "Prepare to draw the gun out of the ditch, advancing." The gun having been lowered, and the men being ſituated, as above, 4 and 7 unhook from the drag-waſhers, and hook to the breaſt eye-bolts. 5 and 8 ſlip under the ropes, and 6 and 9 round the loop ends. 1 and 10 detach their ropes from the naves. 2 and 11 ſlip under the ropes, and 12 and 3 round the loop ends. 1 will paſs his right hand (holding his hook) under the felloe immediately below the horizontal one, will apply his hook, with the circular part uppermoſt, to the circumference of the wheel, and will, with his left hand, put the chain into the eye of the hook, 2 and 3, at the ſame time, laying the reſt of the chain, and a part of the rope, in coincidence with the circumference, from the hook to the higheſt point of the wheel, where the tangent part of the rope commences. 10, 11 and 12, will perform the ſame operation on the oppoſite ſide; the contrary hands to thoſe of No. 1, 2 and 3, diſcharging the ſimilar duties. All being thus ſituated, No. 18 will give the word "March," and "Halt;" (when he obſerves the wheel ropes beginning to deſcend under the horizontal line), "Right ſhift:" on which the left and centre ropes will hold on a ſtrain, while the right is ſhifted to a ſimilar hold as the original one. When the right is refixed, No. 18. gives the word "Left ſhift:" on which the right and two centre ropes will ſuſtain the gun, till the left ſhall be refixed, when the word "March" will be given; and this alternate operation will be repeated till the duty ſhall be effected. When the gun is drawn out of the ditch, 1 and 10 will unfix the hooks from the felloes of the wheels, and hook on to the drag-waſhers, on which, at the word "March," the gun moves on. The dotted lines on figure 2. repreſent the diſpoſition of the ropes, and the rrangement of the gunners in drawing the gun out of the ditch.

"Prepare

" Prepare to lower the gun into the ditch, retreating."

See plate I. fig. 3.

All being in retreating poſition, as *per* fig. 1. 5 and 8 ſlip under the ropes, and 6 and 9 round the loop ends. 4 and 7 diſengage from the drag-waſhers, ſlip round the chain ends, and, aſſiſted by 16 and 15, attach their ropes to the naves. 17 and 18 untruck, take out the traverſing handſpike, and retire to their reſpective ſides, as will alſo 13, 14, 15, 16 and 19, to be removed from any danger from the accidental breaking looſe of the gun; a precaution always to be attended to, relative to uſeleſs men about the gun, in theſe operations.—Thus ſituated, as *per* figure 3. the trail ropes draw the gun into the ditch, checked by the nave ropes.

" Prepare to draw the gun out of the ditch, retreating." 5 and 8 will ſlip under the ropes, and 6 and 9 round the loop ends. 4 and 7 will diſengage from the naves, ſlip round the chain ends, and attach their ropes to the felloes of the wheels; as directed in drawing the gun out of the ditch, advancing. 17 and 18 will truck, and put in the traverſing handſpike, to facilitate this operation. The doted lines, on fig. 3. ſhew 4, 5, 6, 7, 8 and 9, arranged for the laſt operation. Should the inclined plane, over which the gun moves, be long, the ropes will be ſhifted on the wheels, as before deſcribed.

In going through the manœuvres and field-evolutions with a battalion, if the ground is uneven, it will be neceſſary to check an over rapid progreſs of the gun. To effect this, in advancing, Nos. 1, 2, 3, 10, 11 and 12, fall back; and, in retreating, Nos. 4, 5, 6, 7, 8 and 9; and, on the gun's attaining again to level ground, the word, " Prepare to advance," re-arranges all as before.

N. B. In

N. B. In checking, advancing, 2, 11, 1 and 10, paſs under the ropes, and 3 and 12 round the loop ends. In checking, retreating, 7, 8, 4 and 5, paſs under the ropes, and 9 and 6 round the loop ends. 2 and 11, 5 and 8, will raiſe the ropes a little high, to give 1, 10, 4 and 7, an opportunity of paſſing under, without being under the neceſſity of bending too low; and 1, 10, 4 and 7, will carry round the drag-waſhers, with the hands unoccupied by the pins.

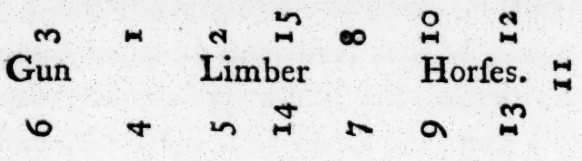
It being highly probable, that the Royal Edinburgh Volunteer Artillery, ſufficiently numerous to work 9 light ſix-pounders, would be furniſhed with a proper complement of guns and howitzers, the following exerciſe, ſuppoſing fifteen men to a gun, was formed for their uſe, and rendered as ſimple as poſſible. It is founded on the two leading principles from which ſuch ſyſtem of exerciſes are deduced. Theſe are, "That the ſhorteſt lines ſhould be gone over," and, "that all ſuperfluous motion of the limbs ſhould be avoided."

See plate I. fig. 4.

1 and 2 carry a dragrope. 4 and 5 carry a dragrope. 3, a pace of 30 inches behind 1, carries a dragrope. 6, a pace behind 4, carries a dragrope. 7 loads. 8 ſpunges. 9 fires and tubes. 10 ſerves the vent. 11, aſſiſted by 14, ſteers and trucks. 12 carries a bucket, ſlow-match, and a ſpare portfire and portfire-ſtick. 13 carries cartridges from 14, who carries a cartouch. 15 carries a cartouch, and attends the limber, &c. 9 and 10 cover 7 and 8. 13 and 12, having their heels in a line with the rear of the trail-tranſom, are covered by the wheel. 1, 2, 4 and 5, ſtand, having elbows within two inches of each other. 14 ſtands a pace behind 11, and 15 (when at exerciſe) two paces in the rear of 14. When the gun is loaded, at the word "Ready," 9, 10, 12, 13, 11 and 14, ſtep clear of the recoil. In advancing

vancing or retreating, 12 gives his ſlow-match to 13, to prevent his blowing up the tube-box of 10, and to enable him to drag more effectually. In action-poſition, 13 returns his ſlow-match to 12, always under the traverſing handſpike, that no ſparks may be blown from it by the action of the wind, which would be the caſe were it handed acroſs the trail with a high flouriſhing motion.

ORDER of MARCH, when 15 are ſtationed to a GUN.



11 unchains. 13 and 12 lift up the trail of the carriage. 4, 6, 1 and 3, take off the tarpauling. 15 and 10 take off one, and 14 and 9 the other ſide box, and place them on the limbers. 10 and 9 ſecure them there. 7, 8, 12 and 13, unlaſh the ſide arms. 2 and 5, 6 and 3, get ready their dragropes, and the whole will fall into poſition for action. In marching, when an attack is expected, 7 and 8 will be in their places, and 14 and 15 in front of 13 and 12. When the gun is re-limbered, the ſame numbers will diſcharge the ſame duties reverſed. If there are 3 or 2 horſes, the above are along the ſides of the carriage and limbers, 11 being to one ſide.

DRAGROPE EXERCISE with 15 to a gun.

"Prepare to advance." 1 and 4 go round their hook ends, taking the centre pins on the inſide, and giving their hooks (after having ſlipped round the hook-ends,) to 8 and 7, who will hook them to the breaſt eye-bolts, and take the rear pins on the inſide. 2 and 5 will ſlip round their

their loop ends, taking the front pins on the inſide. 3 and 6 will hook to the drag-waſhers, and take the rear pins on the outſide. 10 and 12, 9 and 13, will move up, quickly, on the right and left, and receive the ropes, (thrown out to them by 3 and 6, when hooking,) taking the centre and front pins on the outſide; when all will be arranged, as per advancing poſition, fig. 4.

"Prepare for action."—8 and 7 will unhook from the breaſt eye-bolts, and fall into their ſtations. 1 and 4 will ſlip under the ropes, 2 and 5 round the loop ends, and will fall back to their places, each diſpoſing properly of his part of the dragrope he is attached to. 3 and 6 will unhook from the drag-waſhers, and coil up their ropes, brought back to them by 10 and 12, 9 and 13, in paſſing to their ſtations. The whole will be ſituated as per action poſition, fig. 4. In advancing and retreating, the gun is trucked. In action poſition, it is untrucked. In action poſition, 1 and 3, 4 and 6, hold their hooks, reſpectively, in their left and right hands. 1 and 4 hold the ends of the hook-chains and rear pins in their right and left hands. 2 and 5 hold the centre pins in their left and right, and the ſlack of the ropes in their right and left hands, in a looſe coil. 3 carries the ſlack of his rope, coiled over his right, and 6 over his left arm.

"Prepare to retreat."—14 will move round to his right, and 15 to his left, to take the places of 8 and 7, when there is no action-retreating. 14 will, previouſly, aſſiſt 11 in trucking. If the gun is to retreat in quick time, 14 will aſſiſt 11 in ſteering. 1 and 4 will go round their hook ends, taking the centre pins on the outſide, and giving their hooks with their right and left hands to 8 and 7, who will hook on with their right and left hands to the drag-waſhers, taking the rear pins on the outſide. 2 and 5 will ſlip round their loop ends, taking the front pins on the outſide. 9 and 13, 10 and 12, will face to the right and left about, move

 out

out to the rear, and take the centre and front pins of the ropes, received from the left and right arms of 3 and 6, who go to the right about, transferring their hooks and coils to the contrary hands which held them in action-poſition. 3 will hook to the trail ſtaple with his right, and 6 with his left hand, taking the rear pins on the outſide; when all will be in retreating poſition, fig. 4. No. 8, in checking, gives the ſpunge-ſtaff to No. 1.

"Prepare for action."—14 and 15 will move to the right and left, to their places. 8 and 7 will unhook from the drag-waſhers and take poſition. 1 and 4, 2 and 5, will go round the hook and loop ends, take poſt, and arrange their ropes as directed, placing themſelves in a line with the axle-tree, 1 and 4 being a yard from the waſhers. 3 and 6 will unhook from the trail-ſtaples, go round their chain ends, take their places, coil, and take their hooks as directed. 10 and 12, 9 and 13, will move up to their ſtations, bearing up the ſlack part of their ropes to 3 and 6. In checking, advancing, 3 and 6, 9 and 10 will paſs under the ropes, and 13 and 12 round the loop ends. In checking, retreating, 1 and 4, 7 and 8, will ſlip under the ropes, and 2 and 5 round the loop ends. In preparing to advance, or retreat, when marching, theſe movements will be reverſed.

The DITCH-EXERCISE, with 15 to a LIGHT SIX-POUNDER.

See Plate I. fig. 5.

(The gun advancing) "Prepare to lower the gun into the "ditch, advancing."—3 and 6 will unhook from the drag-waſhers, go round their hook-ends and faſten to the naves. 9 and 10 will paſs under the ropes, and 12 and 13 round the loop ends. 8 and 7 will unhook from the breaſt eye-bolts, go round their chain ends, and hook to the drag-waſhers with their left and right hands, reſpectively. 1 and

4 will paſs under the ropes, and 2 and 5 round the loop ends. The whole being ſituated, as per the undotted lines of fig. 5, the front ropes advance the gun, while the nave ones check it, according to the degree of the declivity. 11 and 14 untruck, and take out the traverſing handſpike, and refix them when the gun is lowered.

" Prepare to draw the gun out of the ditch, advancing." All being ſituated as above, 8 and 7 will unhook from the drag-waſhers, go round their chain ends, and, with their left and right hands, reſpectively, will hook to the breaſt eye-bolts. 1 and 4 will paſs under the ropes, and 2 and 5 round the loop ends. 3 and 6 will detach their ropes from the naves, go round their chain ends, and fix to the felloes, (as before deſcribed minutely) 6 being ſuppoſed in the place of 10 in the exerciſe having 21 to a gun. 9 and 10 will paſs under the ropes, and 12 and 13 round the loop ends, when the whole will be ſituated, as per the dotted lines of fig. 5. The ropes will be ſhifted, as formerly detailed, till the gun is drawn out of the ditch.

" Prepare to lower the gun into the ditch, retreating."

See Plate I. fig. 6.

8 will give his ſpunge-ſtaff to 1, who will return it when the duty is effected. 11 and 14 will untruck and unhand-ſpike, when the gun is lowered. 8 and 7 will unhook from the drag-waſhers, go round their chain ends, and faſten round the naves. 1 and 4 will ſlip under the ropes, and 2 and 5 round the loop ends, and all being ſituated, as per the undotted lines of fig. 6. the trailropes will draw the gun into the ditch, while the naveropes check it in its deſcent.

" Prepare to draw the gun out of the ditch, retreating." 8 (1 ſtill holding his ſpunge-ſtaff,) and 7 detach their ropes from

from the naves, go round their hook ends and fix to the wheel-felloes, as before deſcribed. 1 and 4 will paſs under the ropes, and 2 and 5 round the loop ends, when all will be ſituated, as per the dotted and trailropes of fig. 6th.—The right and left ropes will be ſhifted, No. 11 giving the words "Halt; Right ſhift; Left ſhift; March," &c. till the gun ſhall have been drawn out of the ditch.

To Retreat from Advancing Position.

"Prepare to retreat." 3 and 6 will unhook from the drag-waſhers, go round their hook ends, and hook to the trail-ſtaples. 9 and 10 will paſs under the ropes, and 12 and 13 round their loop ends. 8 and 7 will unhook from the breaſt eye-bolts, and hook to the drag-waſhers, when the whole will move into retreating poſition, fig. 4.

To Advance from Retreating Position.

"Prepare to advance." 8 and 7 will unhook from the drag-waſhers, and hook to the breaſt eye-bolts. 1 and 4, 2 and 5, will move round to the front. 3 and 6 will unhook from the trail-ſtaples, go round their chain ends, and hook to the drag-waſhers. 9 and 10 will paſs under the ropes, and 12 and 13 round the loop ends, when the whole will move into advancing poſition, as *per* fig. 4.

"Prepare to fire retreating." 1 and 4 will go round their hook ends, and hook to the trail-ſtaples. 2 and 5 will go round their loop ends, and take the centre pins. 3 will coil his rope over his left arm, and 6 over his right, when both will move to the rear, taking the front pins. At the word "Ready," given by 11, 9 and 10, 12 and 13, will ſpring one pace to the right and left; 11 will ſpring two paces,

paces, obliquely, to the rear, and 1 and 4 will unhook, moving one pace, obliquely, to the rear, to be clear from the recoil line. When the gun has been fired, 1 and 4 will hook, and all will regain poſition. At exerciſe, 14 will be on the left, on the outſide of the rope, as far advanced as 11, and 15 will be two paces behind him. If the gun is retreating in ordinary time, 7, 8, 9, 10, 12 and 13, will not change front; No. 10 ſerving the vent with the proper hand. When the gun retreats, No. 9 and 10 will move off with their reſpective feet neareſt to the wheels, keeping as near the cheeks as poſſible. Should the pull be heavy, 2 and 5 will ſlip under the ropes, and 3 and 6 round the loop ends, 10 and 12, 9 and 13, taking their places. At the word "Ready," 10 and 12, 9 and 13, will fall into their own ſtations. "Prepare for action." 1 and 4 will unhook and go round their hook ends. 2 and 5 will go round their loop ends. 3 and 6 will take their proper ſtations, placing their ropes in their hands, as in action poſition.

"Prepare to fire advancing." No. 11 will give the words, "Point. Ready. Fire." 3 will coil his rope over his right, and 6 over his left arm. 3 and 6 will ſpring up into a line with 1, 4, 2, 5. When the gun has fired, 1 and 4 will hook to the drag-waſhers, when 1, 2, 3, 4, 5 and 6, will move up into advancing poſition. At the word "Halt," they will fall back into a line with the axletree. Should the gun be going up along an inclined plane, 2 and 5 will ſlip under the ropes, and 3 and 6 round the loop ends. 8 and 7 will fall in oppoſite to 1 and 4, and 10 and 12, 9 and 13, will take the centre and front pins on the outſide. At the word "Halt," all will fall back into their ſtations. At the word "Ceaſe firing," 3 and 6 will fall in behind 1 and 4. In quick firing, advancing on an enemy, the dragrope men may fall back into an angle of 450 only, with the gun; 1 and 4 always unhooking. Grape-ſhot will not diverge, in

its

its initial flight, ſo much as to endanger theſe men whoſe lines of poſition form a right angle in front of the ~~trail~~ tranſom.

N. B. The guns are not to be loaded while they are advancing.

Dragrope exerciſe, when the whole ſtrength of the gun is applied to two ropes, a caſe which may ariſe, when, by any caſualty, a rope may be rendered unſerviceable.

See Plate I. fig. 7.

On ground which is level, 1, 2, 3, 4, 5 and 6, will advance, or retreat the gun, as deſcribed under the head "Firing advancing;" and in retreating, the drag-waſhers will be uſed inſtead of the trail-ſtaples. Whenever "Ordinary time" precedes the word of command, "With "one pair of dragropes prepare to advance," or "Retreat," it is to be underſtood that 1, 2, 3, 4, 5 and 6, only, are to act. If "Quick" is ſubſtituted in lieu of "Ordinary time," 12 men will drag the gun, as *per* fig. 7.

"Quick, with one pair of dragropes prepare to advance."

1 and 4 will take the rear pins on the outſide, fixing their hooks to the drag-waſhers. 2 and 5 will paſs under the ropes, and 3 and 6 round their loop ends. 10 and 12 will move up on the right, and 9 and 13 on the left, taking the centre and front pins, oppoſite to 2 and 3, 5 and 6, on the inſide. 8 and 7 will take the rear pins on the inſide, oppoſite to 1 and 4; when all will be arranged, as *per* fig. 7. in advancing poſition. 3, in advancing, will have his rope (if even unſerviceable) on his left arm, and 6 on his right. 11 and 14 truck.

"Prepare

" Prepare for action." 1 and 4 unhook. 10 and 12, 9 and 13, move back to their places. 8 and 7 fall into their ſtations. 2 and 5 paſs under the ropes, and 3 and 6 round their loop ends; all going into action poſition. 11 and 14 will untruck.

" Quick, prepare to retreat with one pair of dragropes."

The whole (excepting 1 and 4, who remain as they are) go to the right about,—2, 3, 5 and 6, paſs their ropes over their heads, as deſcribed in detailing the exerciſe with 21 to a gun. 1 and 4 give their hooks to 8 and 7, who hook them to the drag-waſhers, 1 and 4 taking the rear pins on the inſide. 2 and 5, 3 and 6, take the centre and rear pins on the outſide. 9 and 10, 12 and 13, move to the rear, and take the centre and front pins oppoſite to 5 and 2, 3 and 6. 8 and 7 take the rear pins oppoſite to 1 and 4. 3 will have his ſpare rope (ſuppoſed uſeleſs) over his left, and 6 over his right arm. 14 and 11 will truck. 12 will give his linſtock to 13. 15 goes round to the place of 7, when all will be ſituated as *per* fig. 7. retreating poſition.

" Prepare for action." 8 and 7 will unhook from the drag-waſhers, and fall into their places. 2 and 5 paſs under the ropes, and 3 and 6 round their loop ends. 10 and 12, 9 and 13, will move into their ſtations, as alſo 2, 3, 5 and 6. 11 and 14 will untruck; and 15 will fall back into his place.

N. B. The drag-waſhers are preferred to the trail-ſtaples, in this ſingle rope exerciſe, as the pull is more horizontal and powerful than it would be from the trail; and, particularly, as this poſition of the ropes affords room to the men to arrange themſelves on the in and outſides.

(From

(From advancing poſition) " Prepare to retreat."

1 and 4 unhook from the drag-waſher, and hook to it again, in order that the point of the hook may be downwards. The whole move round into retreating poſition.

(From retreating poſition) " Prepare to advance."

1 and 4 unhook from the drag-waſhers, and hook on again in advancing poſition, into which all move.

N. B. 1 and 4 in unhooking, and taking action poſition, will always turn the drag-waſhers under the axletree, to be ready for the hooks, in either direction.

Wheeling.

The expreſſion, " On centre," will always precede a wheeling order, as it indicates that ſuch an order is immediately to follow, and ſerves as a preparative for being ready to obey it. The gun ſhould be wheeled entirely by the lever power of the traverſing handſpike and trail. If the ropes are made uſe of, the movement they produce, being in a great meaſure a mixed lateral and progreſſive one, will occaſion a change of ground from the original poſition of the gun, which, in a neat execution of manœuvres, is to be avoided. In artillery wheeling, the men will face to the hand wheeled to, and move at the rate of 108 paces in a minute; battalion time of 120, being too quick for artillery. In all wheelings, the men move to their own right or left, according to the direction they are in.

" On

"On centre," { Right wheel. / Left wheel. / Right about wheel. / Left about wheel. / Half right wheel. / Half left wheel. } "Advancing or retreating."

To combine the above field-piece exercise at drill, the words of command will be "Prepare to advance." "Prepare for action." "Prepare to retreat." "Prepare for action." "Prepare to advance." (From this position,) "Prepare to retreat." From this position, "Prepare to advance." All the wheelings, checkings, and half wheelings, in advancing and retreating order.—"Prepare to advance." "Prepare to lower the gun into the ditch, advancing." "Prepare to draw the gun out of the ditch, advancing." "Prepare to retreat." "Prepare to lower the gun into the ditch, retreating." "Prepare to draw the gun out of the ditch, retreating." "Prepare for action." "Prepare to fire three rounds, retreating." "Prepare for action." "Prepare to fire three rounds, advancing."—To this drill abstract may be added, occasionally, though not the most serviceable species of exercise; "Quick, with one pair of dragropes prepare to advance." "Prepare for action." "Prepare to retreat." "Prepare for action." "Prepare to advance." "Prepare to retreat." "Prepare to advance." "Prepare for action." "Change round;" or, "Right about face." "Break off."

Such is the dragrope exercise. It has been circumstantially detailed, in order that it might be clearly understood. Experience has evinced, that a perfect knowledge of it may be acquired in a very inconsiderable period of time, and that when once thoroughly comprehended, it is easily retained in memory.

The following manœuvres were practiſed, to render the corps expert in accompanying the battalion to which it is attached, (the 1ſt regiment of Royal Edinburgh Volunteers,) in its field-evolutions.

1. The artillery, in column, will march round, in ordinary and quick time, in alignement.

2. The line will advance, halt, and fire from flanks to centre.

3. The line will retreat, halt, and fire, from centre to flanks.

4. The line will change front to the right, and fire from right to left.

5. The artillery will reform line.

6. The line will change front to the left, and fire from left to right.

7. The artillery will reform the line.

8. The artillery will form the great ſquare, and fire from flanks to centre, in line ſucceſſion.

9. The artillery will reduce the ſquare.

10. The artillery will form the ſmall ſquare, and fire from centre to flanks, in line ſucceſſion.

11. The artillery will reduce the ſquare.

12. The artillery will march in alignement, in file, in quick time.

13. The artillery will fire, retreating in line.

14. The artillery will form en echellon, and fire from flanks to centre.

15. The artillery will reduce the echellon into line.

16. The artillery will paſs through a defile.

17. The artillery will retreat over a bridge.

18. The artillery will form cloſe column on the right brigade.

19. The artillery will deploy into line.

20. The right wing will advance, under the fire of the left, which will then form up with it.

21. The left wing will retreat, under the fire of the right, which will then retreat into line, under the fire of the left.

22. The artillery will form en potence on the right wing.

23. The artillery will reduce the en potence into line.

24. The artillery will form en potence on the left wing, and fire three rounds from flanks to centre.

25. The artillery will reduce the en potence into line.

26. The artillery will retreat by alternate guns.

27. The artillery will move to the flanks, to battalion diſtance, form line, and fire a royal ſalute.

When guns move off, halt, or wheel together, the *ſenior* officer of the diviſion gives the word. Each officer gives the word, when the guns act ſeparately, or ſucceſſively. The officer will march two paces in front of his dragrope-men. In line, on the right, the officers will take poſt between the dragrope-men and wheel, to the right. The officers of the left wing will rank from the left. When the guns are firing, the officers are in all ſituations, ſo as to direct their fire moſt effectually. On the march, the officers will take poſt behind the gun. The drums and fifes will fall in, in the centre.

The corps being armed with ſwords, when the order of march is formed by the non-commiſſioned officers of the guns, the general words of command will be, "Handle "ſwords;" the right hand is applied to the hilt, and left to the

the ſcabbard. (" Draw ſwords;") they are drawn, and held perpendicularly, the right hand being breaſt high, and the left dropping down by the ſide. (" Carry ſwords;" the blade is let fall into the left hand, raiſed to meet it, and is carried at an angle 60°. (" Return ſwords,") two motions; the ſword is ſheathed, and the hands drop to the ſides.—If a compliment is to be paid on the line of march, the men will be ordered to " Port ſwords," when they will raiſe them to a perpendicular direction, the right hand being breaſt high. The officers will, in this caſe, drop their points, when the men are raiſing theirs.

Manoeuvres.

March means ordinary time.

1. The artillery, in column, will march round, in ordinary and quick time, in allignement.

See plate I. fig. 9.

Right brigade, " Prepare to advance." " Slow march." Inner gun, when at b. " Halt, on centre left wheel, halt." Right gun, when at a. " Halt; on centre left wheel; " march." When at c. " Halt."—*Senior* officer gives the word " March." This is repeated at each angle. The left and centre brigades march round on the ſame principle. The right centre, and left brigade left gun, wheel to the right, and the left centre, and inner left guns, move on the inſide; and reverſe theſe movements in wheeling into line. The movement is ſo obvious, that it is unneceſſary to detail the words of command to each gun.

N. B. A detachment of pikemen follow each gun in all theſe manœuvres, viz. 1ſt, 2d, 3d and 4th diviſion, from the right.

2. The

2. The line will advance, halt, and fire three rounds from flanks to centre.

" Prepare to advance." " March." " Halt." " Prepare " for action."

3. The line will retreat, halt, and fire two rounds, from centre to flanks.

" Prepare to retreat." " March." " Halt. " Prepare for action."

4. The line will change front to the right, upon the inner right gun, and fire two rounds from right to left.

Inner right gun, by the trail, " On centre right wheel."

Right gun, " Prepare to retreat." " March." " Halt." " Right wheel." " March." " Halt." " Prepare for ac- " tion."

Inner left gun, " Prepare to advance." " March." " Halt." " Right wheel." " March." " Halt." " Pre- " pare for action."

Left gun, " Prepare to advance." " Half right wheel." " March." " Halt." " Half right wheel." " Prepare for " action." See plate I. fig. 10.

5. The artillery will wheel into or reform the line. To effect this, the words of command of the laſt manœuvre will be reverſed.

6. The line will change front to the left, and fire two rounds from left to right.

See plate I. fig. 11.

7. The artillery will reform the line.

The words of command for effecting this and the laſt manœuvre, are obvious from the detail of thoſe of the 4th.

If

If the line conſiſts of any number of guns, in changing from line to the right or left, excepting the three right, or three left guns, they all oblique like the left gun of manœuvre 4th, or the right gun of manœuvre 6th.

8. The artillery will form the great ſquare on the flank guns, and fire two rounds from flanks to centre, in line-ſucceſſion.

See plate I. fig. 12.

Right gun, " On centre, right wheel."—Left gun, " Left " about wheel."

Inner right gun, " Prepare to advance."—" March."—" Halt."—" Right wheel."—" March."—Halt."—" Left " wheel."—Prepare for action."

Inner left gun, " Prepare to advance."—" March."—" Halt."—" Left wheel."—" March."—" Halt."—" Pre-" pare for action."

9. The artillery will reduce the great ſquare into line.—Right gun, " On centre, left wheel."—Left gun, " Right " about, wheel."

Inner right gun, " Prepare to retreat.—" Half right " wheel."—" March."—" Halt."—" Half left wheel."—" Prepare for action."

Inner left gun, " Prepare to retreat."—" Half right " wheel."—" March."—" Halt."—" Half right wheel."—" Prepare for action."—During the execution of reducing theſe manœuvres, the officers commanding the diviſions of pikemen will form them in the rear of their reſpective guns with the leaſt poſſible movement, and with the feweſt words of command. When the line is formed, the 2d and 3d diviſions will join in the centre; the firſt diviſion going to the right, and the 4th to the left.

10. The artillery will form the ſmall ſquare, and fire two rounds from centre to flanks, in line-ſucceſſion.

See plate I. fig. 13.

This ſquare is formed on the inner flank-guns; and the mode of forming it, is obvious from the detail of the preceding evolution; they are arranged as a, b, c, d. If there are ſix guns, they take poſition in the great ſquare in the arrangement 1, 2, 3, 4, 5, 6. In this caſe, the ſix diviſions of pikemen will form cloſe column on the right diviſion, in the centre of the ſquare, and deploy into their reſpective ſituations when the ſquare is reducing. In line, the 2d, 3d, 4th and 5th diviſions will take poſt behind their guns; and the 1ſt and 6th (if there are ſix guns) on the right and left flanks. In forming the ſquare, the guns move over the baſe and perpendicular of a right-angled triangle, and, in its reduction to line, the ſame guns move along the hypothenuſe. This is done, that practice may be afforded in the varieties of wheeling. On ſervice, the ſhorteſt line leading to the object muſt be adopted.

11. The artillery will reduce the ſmall-ſquare. Mode obvious.

12. The artillery will march, in file, in alignement, in quick time.

Right gun, "Prepare to advance."—"Quick march." "Halt."—"On centre, left wheel."—"Quick march," &c. till it arrives on its original ground. The other guns will wheel to the left on the ground of the right gun.—"Artillery, left wheel into line."

13. The artillery will fire, retreating in line.

Firing, advancing, being a part of this movement, the line will fire ſix rounds, advancing, and ſix, retreating; the guns advancing or retreating two paces after each fire. The diviſions of pikemen keep in the rear of their guns.

14. The artillery will form en echellon, and fire two rounds from flanks to centre.

See plate I. fig. 17.

Right gun, " Half right wheel."—Left gun, " Half left " wheel."

Centre guns, " Prepare to advance,"—" March."—" Halt."—" Prepare for action."—The diviſions of pikemen will keep in the rear of their guns. If ſix guns are in line, the centre guns move out in front to twice their own central diſtance, and the inner flank-guns will take poſt in the ſides of the echellon.

15. The artillery will reduce the echellon into line.

The front guns retreat, and the flank guns half wheel into line.

16. The artillery will paſs through a defile.

See plate I. fig. 14.

The right gun will occupy the riſing ground B, having on the right the impervious wood E, and ſmall road. The left gun will take poſſeſſion of the riſing ground A. having the wood F on the left. Theſe guns will flank and cover the centre guns in moving through the defile C. When the centre guns have paſſed, they cover the flank guns while forming up with them. If there is a danger of being charged, the ſmall ſquare will be immediately formed, having the pikemen, in column, in the centre, to be ready to act as the emergency may require.

17. " The artillery will retreat over a bridge."

This is the reverſe of the former evolution. The flank guns paſs, covered by the fire of the centre guns. The flank guns form on the oppoſite ſide, covering the centre guns in their retreat. The right and left diviſions of pike-

men

men will join the centre ones, and accompany the centre guns retreating. The diviſions will retreat in file.

18. The artillery will form cloſe column on the right brigade.

See plate I. fig. 15.

The inner right will oblique behind the right. The left will move along the front and occupy the place of the inner right. The inner left will oblique to the rear of the left.

If there are ſix guns, the centre brigade will retreat, wheel to the left, and form behind the left brigade, which in this caſe forms in the rear of the right, and the officers rank from front to rear. If two lines of three guns are to be formed from a line of ſix guns, the officers will rank from right to left of both lines.

In this laſt caſe, the right, and right centre gun, ſtand faſt. The inner right gun will oblique into the rear of the right gun, while the left gun is moving along the front to occupy the place left by the inner right. The inner left and centre left oblique to the right, into the rear of their reſpective guns.

19. The artillery will deploy into line.

The reverſe of the above movements will effect this.

20. The right wing will advance under the fire of the left, which will then form up with it.

In this caſe, the left will keep up a fire till the right has halted, formed, and commenced firing; when the left will move up rapidly into line.

21. The left wing will retreat under the fire of the right, which will then retreat into line under the fire of the left. This movement is the reverſe of the laſt, bearing reference to the rear.

22. The artillery will form en potence on the right wing.

See plate I. fig. 18.

The right guns ſtand faſt. The inner left a, retreats to proper diſtance, wheels to the left, and prepares for action.

The left gun, b, half wheels to the left, retreats to double diſtance, half wheels to the left, and prepares for action.

The pikemen keep poſted in the rear of their reſpective guns.

23. The artillery will reduce the en potence into line. Reverſe the laſt movements to accompliſh this.

24. The artillery will form en potence on the left wing, and fire three rounds from flanks to centre.

See plate I. fig. 16.

The mode of producing this diſpoſition, the 22. points out.

25. The artillery will reduce the en potence into line. Obvious.

26. The artillery will retire by alternate guns.

After having fired from right to left, which will always precede this manœuvre, the right, right centre, and inner left guns, will prepare to retreat; and moving very rapidly, will gain half the diſtance from the line they left, to the place where the line is to be formed. Having gained this ground, they will halt, and prepare for action. When the left, left centre, and inner right guns, which maintained a continued fire, obſerve that the right guns are formed, they will be ordered by the *ſenior* officer to "Prepare to retreat "firing." They will retreat in this way till they have paſſed the intervals of the right guns, when they will prepare to retreat, and the right guns will commence an independent fire. When the left guns have gained the line of formation, they will halt and prepare for action. The right guns will then retreat firing, till they reach the intervals in the line, when they will halt, prepare for action, and a round will be fired from left to right.

27. The artillery will move to the flanks, to battalion diſtance, and fire a royal ſalute.

The wings move from each other in file, halt, and wheel to the right and left into line. The interval of firing will be

be ſix ſeconds; four being counted on the fingers, and the words "Ready," and "Fire," affording two more. Theſe manœuvres were calculated for the number of guns which the corps could command. With a greater number of guns, they might be increaſed, and varied almoſt indefinitely.

PIKE EXERCISE.

The Royal Edinburgh Volunteer Artillery are provided with pikes, attached to the carriage and limber, on the line of march. Four men are aſſigned to carry 20, the complement of each gun. Theſe, when the gun is poſted, take their ſtations to the right and left of No. 14. On the word, "Prepare pikes," 8 and 7 will ſtep back into a line with 1, 2, 4 and 5. 9 will cover 7. 10 will cover 8. 12 will cover 2. 13 will cover 5. 15 will cover 14 on the left. The pike-bearers will, in an inſtant, from the rear, diſtribute their pikes, and take poſt on the left and right, as 16, 17, 18 and 19. The officer will take poſt on the right, covered by 11, the non-commiſſioned officer. 16 will carry three front and two rear pikes; four of which he gives to 5, 14, 13 and 15, when he will take poſt to the left of 14. 17 will carry three rear and two front pikes, which he will give to 7, 4, 9 and 6, and cover 16. 18 and 19 will act in the ſame manner on the right. On the left flank, 14 and 15 will take poſt on the right; and the officer, covered by 11, on the left. No. 21 will attend the limber.

See plate I. fig. 8.

N. B. 4 will give his rope to 7. 6 his to 9. 1 his to 8, and 3 his to 10.—7, 9, 8 and 10, will throw them acroſs the

the muzzle and breach of the gun. 9 will put his portfire on the locker. 12 will leave his bucket and linſtock at the trail. 14 and 15 will take poſt with the cartouches on.

If 21 are ſtationed at the gun, the non-commiſſioned officers cover each other, and the officer commands generally.

The front rank pikes are 8 feet in length, excluſive of a braſs tube, 5 inches long, attached to the lower end by two rivets, at right angles to each other. The half of the tube is filled with lead, covered in by an iron ferrule. The weight at the bottom brings the centre of gravity, in the charging poſition, near the left hand, which is evidently an advantage in the management of the weapon. The rear rank pikes are longer, in order that all, in a charge, may have the ſame degree of projection. They are an inch in diameter at the bottom, and an inch and 2–8ths at two third parts from the bottom, tapering to an inch, where the head, of 4 ſides, terminating in a point, is fixed.

The Pike Manual conſiſts of Six words and Thirteen motions, correſponding (excepting in fixing bayonets) to thoſe of the infantry manual exerciſe.

Poſition of the Body, as *per* DUNDAS's Exerciſe.

Poſition of ordered Pike.

The lower end of the pike reſts on the ground, and touches the outſide of the ball of the right foot. The right hand is extended downwards, and the inſide of the thumb, fore, and middle fingers, coincides with the pike reſting perpendicularly againſt the right ſhoulder. The pike is held firmly compreſſed in this poſition, between the outſide of the upper part of the thigh, and the inſide of the lower part of the arm.

Poſition

Poſition in ſtanding at Eaſe.

From the above poſition, the right foot is thrown back ſix inches, and planted ſmartly behind the left. The hands at the ſame inſtant meet in front, and cloſe into each other.

Poſition of ſhouldered Pikes.

The pike, at the left ſhoulder, reſts on the ball of the left fore-finger. The thumb, and three other fingers, embrace it with a firm graſp. It is compreſſed in this poſition by the left wriſt, and the inſide of the left arm (not at full extent) againſt the left ſide, and held perpendicularly.

MANUAL EXERCISE.

I.—Order Pike.—Three Motions.

1. The right hand ſeizes the pike, rather above the left ſhoulder.

2. It is carried quickly acroſs the body, with its lower end within three inches of the ground, ſupported between the thumb and three firſt fingers of the right hand extended, and by the left hand carried to the right ſhoulder.

3. It is let fall to the ground, the right hand being brought, at the ſame inſtant, to extend in front, coinciding with it, and the left let fall to the left ſide.

II.—Fix Bayonets.

No correſponding pike motions.

III.—Shoulder Pike.—One Motion.

On hearing the word "Shoulder," the right hand ſlips behind the pike, applied to the hollow between the fore finger and thumb, which, with the two fore-fingers, ſeizes it firmly. The pike is carried acroſs the body, and during this quick lateral movement, is catched with an upward hitch or jerk, by the right hand, within a foot and a half of the

the lower end. The left hand, at the ſame time, receives the lower end of the pike then ſituated at the left ſhoulder, and the right falls inſtantly to its proper ſide.

IV.—Present Pike.—Three Motions.

1. Turn the left wriſt a little inwards, ſeize the pike at the ſame inſtant cloſe under the left ſhoulder, applying the ball of the thumb to the right ſide of the pike.

2. Poiſe the pike, the left hand, and inſide of the left arm, extending (hand open) along the left ſide of the pike, with the top of the left fore-finger as high as, and in front of, the left eye.

3. Lower the pike quickly to the full extent of the right hand and arm, the left ſuſtaining its weight between the inſide of the fingers and thumb; and the hollow of the right foot being brought, at the ſame time, in conjunction with the left heel.

V.—Shoulder Pike.—Two Motions.

1. Bring the pike with the right hand to the left ſhoulder, ſeizing it, at the ſame time, at the lower end, with the left hand, and bringing up the right foot to an angle of 60° with the left.

2. Quit the pike with the right hand, and let it fall down to the right ſide.

VI.—Charge Pike.—One mixed and one ſingle Motion.

1. The pike is ſeized by the right hand, oppoſite to the left elbow. The left hand immediately ſlides eight inches above the right, which, at the ſame inſtant almoſt, deſcends, ſeizing the lower end. The pike is inclined, ſlanting acroſs the body at an angle of 80°; and theſe four motions muſt be combined into one, in order to keep time with the battalion.

2. Half face to the right, bring down the pike to the charge (point breaſt high), and hold it firmly againſt the body,

body, with the arms not extended, but firmly contracted to the ſhoulders.

N. B. The firſt four motions (thrown into one) are termed "Porting pike;" which, ſeparately from the manual, will be effected by the word "Port pike."—The rear rank muſt, in going through the firſt complicated motion, ſtep one pace to the right, to be enabled to bring the pikes down to the charge.

VII.—Shoulder Pike.—Two Motions.

1. Front, bring the pike to the left ſhoulder, and ſupport it with the right hand againſt the ſhoulder.

2. Quit the pike with the right hand.

N. B. In quitting the right hand, the rear rank ſpring one pace to the left.

"Support pike."—Two motions.—The right hand is applied to the part of the pike oppoſite to the left elbow, the thumb being againſt the right ſide, and the left arm is brought horizontally to cloſe or fold over the right.

On the line of march, "Advance pike."—Three motions.

1. The right hand ſeizes the pike under the left ſhoulder.

2. It is carried quickly acroſs the body, held againſt the right ſhoulder by the left hand, between its open fingers and thumb; and below between the open fingers and thumb of the right hand, at its full extent. The right hand, at the ſame time, ſlips to the front of the pike, the right fore-finger lying along the front, and the thumb and three fore-fingers graſping it firmly.

3. The left hand falls to the left ſide.

In the ancient mode of receiving the charge, the pike was ſupported horizontally on the left palm, held ſhoulder high, and the right hand, having the elbow raiſed, held the lower end.

Diſpoſition for receiving a Charge.

All at ordered pikes, at the word "Prepare the Charge," firſt motion; the front and rear ranks will ſlip the hand behind the pike, applying the hollow between the thumb and fore-finger to the back part of it;—the front rank will face to the right on the heels, bringing the left hand to the pike, half way between the elbow and ſhoulder, at the ſame time raiſing the pike over the toes, and applying its lower end to the ball of the right foot. The rear rank will, at the ſame time, throw up the pike to the right ſhoulder, the left ſeizing it where the right held it at the order, the right graſping it at the lower end, and all the rear rank ſpringing, at the ſame time, a ſmall pace to the right These things having been done, the firſt of the two motions will be accompliſhed. Second motion. The front rank will incline the pike at an angle of 45°, the left foot will ſtep out at the ſame inſtant a full pace, ſo that the left leg ſhall be perpendicular, with the pike reſting againſt the inſide of the left thigh, four inches above the knee, the right leg and thigh ſtretched nearly in the direction of the pike. The right hand is, at the ſame moment, applied to the ſword hilt.—The rear rank will come down to the ordinary charge.—The front rank will draw ſwords, in two motions: The firſt; They will draw the ſword, holding it perpendicular, the hilt being breaſt high. The ſecond; They will throw the ſword into a horizontal poſition, as high as the forehead. "Order pikes;" theſe motions will be reverſed. The front rank will uſe the left hand only in coming to the order. In raiſing the pike from the inclined poſition, the right hand and hilt of the ſword drop to the right ſide, the blade pointing upwards, and lying along the pike. Firſt motion, The ſword is ſheathed. Second motion, The hands drop to the right and left.

PART

(To face page 32.)

PART I

MISCELLAN

A Variety of very useful matter, relative to the field-service o
be detrimental to the public interest to publish it, a detail will be

FORM OF REPORT OF

Report of Artillery Practice, carried on by the R. E. V. Arti
Sands, on Monday, 9th July 1798, (the last practice).

	By whom pointed.	Rank.	Number of rounds.	Grazed. Short yards.	Grazed. Beyond ditto.	Grazed. To the right do.	Grazed. To the left do.	Shot, feet Above the centre.	Shot, feet Below the centre.	Shot, feet To the right of do.
Right Gun.	John Campbell,	1st Lieut.	1						3	
	Carlile Bell,	1st Gunr.	2						½	1½
	Burnet Bruce,	Ditto.	3		40		1½			
	Thomas Lattimer,	Ditto.	4						4	
	John Porteous,	Ditto.	5		220	3				
	Roger Ayton,	Serjeant.	6		65		1			
	John Campbell,	1st Lieut.	7	36					3	
	Robert Dundas,	Bombr.	8						4	
	Carlile Bell,	1st Gunr.	9		30		1½			
Left Gun.	James Glasford,	1st Lieut.	1		8		1½			
	William Baillie,	2d Lieut.	2	20					¾	
	Edward Lothian,	1st Gunr.	3					4		
	John Cochrane,	Ditto.	4						2½	
	David Anderson,	Ditto.	5						2	
	William Ballantyne,	Ditto.	6						4½	4½
	David Williamson,	Capt. Lt.	7						3½	
	James Glasford,	1st Lieut.	8						1½	
	Alexander Irvine.	2d Lieut.	9						3½	

Lieutenant-Colonel RIMINGTON,
commanding the Royal Artillery
in North Britain.

ART II.

LLANEOUS.

ld-fervice of Artillery, might be introduced here; but as it might
tail will be written in orders only, for the inſtruction of the corps.

RT OF GUN PRACTICE.

E. V. Artillery, with Two Six-Pounder light Guns, on Leith
ice).

Shot, feet.				Ring.				Direction, feet.				Angle.		Target at 450 yards.
Above the centre.	Below the centre.	To the right of do.	To the left of do.	1ſt.	2d.	3d.	4th.	Above the centre.	Below ditto.	To the right of do.	To the left of do.	Degrees.	Minutes.	Remarks.
	3		3				In		4				30	Hit.
	½	1½			In				4				30	Hit.
									4				30	
	4		4				In		4				30	Hit.
									4				30	
									4				30	
	3					In			4				30	Hit.
	4		4				In						30	Hit.
													30	
									4				30	
	¾					In			4				30	Hit.
4							In		4				30	Hit.
	2½		3				In		4				30	Hit.
	2				In				4				30	Hit.
	4½	4½					In		3½				30	Hit.
	3½					In			3½				30	Hit.
	1½		4½				In		3½				30	Hit.
	3½		4½				In		3				30	Hit.

JOHN MACDONALD,
Capt. R. E. V. Artillery.


BRITISH
15
70
NOV

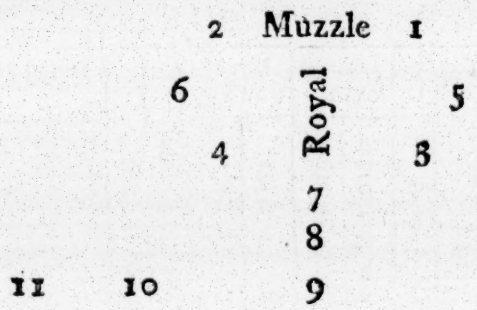
FORM OF REPORT OF MORTAR PRACTICE.

Report of Mortar Practice, carried on by the R. E. V. Artillery, with Three $5\frac{1}{2}$ inch Royals, on

on

Powder ounces	Rank.	Number of rounds.	Elevation.		Range yards.		Time of flight.		Deviation feet.		Weight of shell.	Sand in shell.	Range at 45°
By whom directed.			Degrees.	Minutes.	Actual.	Calculated.	*Per* pendulum.	By calculation.	To the right.	To the left.			Ranges given out. Yards.
													Remarks.

Five men are ſufficient for the management of a royal. 11 are ſtationed, in order that the proceſs of meaſuring, cutting, reducing, and fixing the fuze, may be accurately exhibited.



1 ſpunges. 2 loads, uncaps the fuze, and drudges. 3 ſerves the vent, and carries quick-match. 4 fires. 5 and 6 handſpike. 5 carries a piece of chalk. 6 carries the marking and laying lines. 7 commands and lays the mortar. 8 carries ammunition, a quadrant and perpendicular. 9 is in charge of the ſhells. 10 cuts the fuzes as directed by 7. 10 has a fuze-knife and bench. 11 has ſetters and a mallet, and fixes the fuze.—No. 9 will reckon the pendulum vibrations. The medium range given by a certain number of ounces of powder, at an angle of 45°, will be aſcertained. The ranges for the enſuing practice will be given out; and the officers, and ſuch of the non-commiſſioned officers and 1ſt gunners as chooſe it, will be directed to come furniſhed with the correſponding angles and times of flight, deduced from calculation. The officer commanding at practice, will, as uſual, make a report to the commandant of the Royal Artillery.

ON FUZES.

Suppoſing the reſiſtance of the air uniform, and the action of inflamed powder equal, the inequality in the times of

burning

burning of fuzes of the ſame length, will occaſion the burſting of a ſhell, high in the air, or after it has entered the ground. In either caſe, the exploſion is uſeleſs in its effect. This inaccuracy in the time of burning of fuzes, may proceed from ſix cauſes, but principally from the firſt.

1. It proceeds from the varying phyſical ſtate of body of the perſon driving the fuze by the hand, at different periods of his work, whereby ſtrokes of varying powers are given to the ſame quantity of compoſition; from which it follows, that the ſeveral parts of the driven compoſition will have different denſities, and, conſequently, burn in an ununiform manner; that is to ſay, equal parts of the ſame fuze, having been driven with applications of differing powers of ſtroke, will burn in unequal times, and, therefore, entire fuzes of the ſame cylindrical bore and depth, from the ſame cauſe, will have the ſame effect; from which it is evident, that their application to the times of flight of ſhells, found by theory on the pendulum, will be liable to produce a very inaccurate effect.

2. It may proceed from a difference of diameter of the bores of fuzes, occaſioning ſuch as are of a larger bore than others, to contain more fixed compoſition, which will evidently produce a variation in the times of burning of fuzes of the ſame claſs.

3. It may ariſe from a difference in the cylindrical lengths of the bores, the effect of which will be a greater condenſation of the compoſition, and neceſſarily a ſlower conſumption in burning.

4. It may reſult from the ſhapes of the ladles in uſe for charging the fuze with. Theſe ladles are ſemi-cylinders, rounded

rounded of at one extremity, and riſing in a ſpecies of curve at the other, fixed to a wooden handle. The men employed are apt to puſh theſe ladles into the compoſition, ſometimes near the ſurface, and ſometimes at a greater depth in the box containing it. It is evident, that the ladles will contain more in the ſecond than in the firſt caſe, and that the fuze may thus be filled with varying quantities of compoſition. Without an unremitting attention, ſeldom kept up by the deſcription of men employed, the ſurfaces of theſe ladles with curvilinear edges, will not be regularly levelled, and, therefore, the quantities taken up may vary. The combined effect of the two cauſes under this 4th head, may occaſion a conſiderable variation in the times of burning of fuzes of the ſame kind; that is to ſay, if different quantities are compreſſed with the ſame weight, power, or force, proceeding from a ſtroke, a larger will, of courſe, be leſs denſe or compact in its conſtruction than a ſmaller, and being more porous, and liable to be more immediately acted on by the flame, will burn in leſs time, occaſioning different equal parts of the ſame fuze to burn in unequal times, and fuzes of the ſame kind, in varying times.

5. This inaccuracy may ariſe from inattention in mixing up the compoſition each time, previous to filling the ladles. If this is neglected, the ſaltpetre being the heavieſt body among the ingredients, will naturally ſubſide through the ſmall crevices formed by the minute grains of the ſulphur and mealed powder, the conſequence of which will be, that the charges of different ladles, *ergo*, of fuzes of the ſame ſort, will be of varying temperatures or qualities of mixture, (though loaded with the ſame compoſition), and burn in different times.

6. A ſixth cauſe may be added, proceeding from a diſſimilar ſtate of the weather, during different periods of the operation. In dull cloudy weather, tending to rain, the ingredients forming the compoſition will be affected by the moiſture, and will burn ſlower than the ſame, driven in hot clear weather.—The writer of theſe ſheets ſaw, in the courſe of his practice, the neceſſity of applying a remedy to theſe cauſes of inaccuracy in the burning of fuzes. The 2d, 3d, 5th and 6th, may be removed, probably by a minute attention to the circumſtances ſtated. The 4th may be obviated by making uſe of complete, in lieu of ſemi-cylinder ladles, into which the compoſition may be turned over with a knife, or flat thin piece of braſs, taking it always from the ſurface. Theſe cylinders, fixed on neat wooden handles, can be levelled accurately, and each ladle will be thus uniformly charged. The firſt cauſe of error is the moſt difficult to remove. This, however, has been effected, by ſubſtituting the action of a weight falling through a ſmall ſpace, in lieu of the irregular power of the hand driving or fixing the compoſition with a mallet. The machine termed "The Fuze-driver," has no claim to originality, being only the pile-driver reduced to a ſmall ſcale, and applied to a different purpoſe. It is probable, that a ſimilar machine may have been uſed in driving rockets, merely to remedy a defect in power in the hand, and not to produce the great deſideratum hitherto wanted, "equality of burning;" as rockets burn in varying times, and hence the inequalities obſervable at different points of their flight. The fuzes driven by this machine have been repeatedly tried, and found to burn in equal times; or at leaſt, within a medium difference of a quarter of a ſecond. It may be poſſible, (for it has been done), after repeated experiments, conducted with a minute attention to avoid cauſes of inaccuracy, to ſelect, from twenty or thirty men, five,

five, who will produce fuzes almoſt as good as thoſe driven by the machine. In general, however, this will not be the eaſe, unleſs the hand acts more ſteadily in this than in a warmer climate, where it is a known fact, that it acquires a nervous tremor from an affection of the nervous ſyſtem. The fuze-driver was, when firſt conſtructed, a complicated machine, worked by four men. It is now ſimplified in conſtruction, and requires two men only. The following rough ſection of it, ſerving at the ſame time as an elevation, will give a ſufficient idea of the machine. The part of the rope 9 to the left, though not ſeen in ſection, is thrown in.

See plate I. fig. 19.

3 is a ſolid block of wood, or a ſtrong table, in which are fixed the two uprights 1, 1, four inches ſquare, of braſs, and connected at the top by the croſs bar 10. The uprights are four feet high, and are fixed firm to the block, by lateral inclined braces. The diſtance between them is eight inches. 2 is a braſs weight of 33 pounds, travelling in grooves in the uprights, an inch ſquare, and an inch in depth. The parts of the weight fitting theſe grooves, are only two-third parts of its length, and have on them the whole friction of the weight in aſcending and deſcending. Theſe parts fitting the grooves, are repreſented by two dark lines on the ſides of the weight. 8 is a braſs pulley, fixed in the croſs-piece 10. Over this pulley is a rope 9, which raiſes the weight. 4 is a ſmall moveable block, having a hole in which it receives the fuze 5 up to its neck nearly. 6 is the drift let into the fuze 5. 7 is the ſpace between the top of the drift and the bottom of the weight, through which equal ſpace, the weight falls in acting on the drift, which condenſes the compoſition in the fuze. The rope is fixed to a piece of wood one foot in length, in order

that

that the weight may be raiſed by both hands. The block 3 ſhould have ſquare holes, (11) knee-high, cut in it, ſufficiently deep to admit the knees of the two men who work (one on either ſide) near the weight, and take off all conſtraint of poſition. We ſhall call thoſe working the machine numbers one and two. One has his box of compoſition reſting on the block, alſo his fuze, drift, ladle, a braſs or copper knife, having a thin flat blade, a cylindrical piece of copper, two inches and a quarter in length, and two tenths of an inch in diameter, termed his meaſurer. Number two's province is ſolely to raiſe and let fall the weight. No. 1 commences by placing the box 4, with its hole exactly under the centre of the weight. He fixes it in this poſition, by pins let into holes on its four ſides. He mixes up his compoſition carefully and ſlowly, (that the light ingredient, the mealed powder, may not fly off) before he loads each ladle. He puſhes his flat knife always with the ſame velocity of hand along the ſurface of the compoſition, taking up a ſufficient quantity to fill the cylindrical ladle, into which the compoſition is gently diſcharged. He draws the meaſurer along the top of the ladle in order to level it, the ſuperfluous compoſition falling into the box. He holds the fuze inclined to one ſide, and diſcharges the compoſition ſlowly into it, that the air diſplaced by it in the bore, may not ruſh out too ſuddenly, and carry off ſome of the light part of the ingredients. He places the fuze in its poſition under the weight, by carrying his left hand round the left pillar of the machine. He gently introduces the drift into it. He holds the bowl of the fuze, reſting in its hole, with the 2d, 3d, and 4th fingers of his left hand, and the drift, in the fuze, between the thumb and fore-finger of the left, holding it looſely. No. 1 has now raiſed the weight about three inches above the top of the drift. No. 2, with his right hand, applies

his

his meaſurer, perpendicularly, on the top of the drift. No. 1 gently lowers the weight till it touches the top of the meaſurer, on which No. 2 withdraws it, and No. 1 inſtantly lets fall the weight, and raiſes it as before, on which No. 2 looſens the drift, holding it between his thumb and finger, and introduces the meaſurer as before, to repeat the operation. $5\frac{1}{2}$ inch fuzes receive five of theſe ſtrokes, and ſeven muſt be given to thoſe of a larger ſize. By raiſing the weight higher, one ſtroke, inſtead of five, might be thought to produce a ſaving of time and labour; but one ſuch ſtroke would ſplit the fuze. It is cuſtomary to drive with the laſt ladleful of compoſition, two ſtrands of quick-match, at right angles to each other, that they may catch fire from the exploſion of the charge in the chamber of a mortar. The part of the bore of the fuze, having this driven or fixed quick-match in it, will contain a mixture of compoſition and match, that will burn in leſs time than an equal part of the ſame fuze. To prevent this, a bit of pin ſhould be fixed in the ſide of the bowl of a fuze; and through the eye formed by this bent piece of pin, a ſtrand of quick-match may be paſſed. This contrivance has been adopted in India, as the fuze, in that caſe was accurately filled up with compoſition only. It has been uſual to cut fuzes in a ſlanting direction, acroſs the axis. By this mode, it will be difficult to cut the fuze at any determinate point; and, therefore, to exclude all poſſibility of error, it ought to be ſawed acroſs perpendicular to the axis. It was urged in ſupport of the former mode of cutting, that the ſlanting inclined plane of the cut compoſition, afforded a greater field of fire for the inflammation of the charge in the ſhell, than the perpendicular plane at right angles to the axis. The fact is, that in either caſe, the ſpark attains to the powder at the ſame inſtant, if the diſtance from the bowl of the fuze to the initial point of the compoſition is the

ſame,

ſame, and that the certainty of proportioning the length of the fuze to the time of flight, is infinitely in favour of the ſecond mode. In uſing the fuze-driver, a contrivance might be adopted, calculated to ſave time and diminiſh labour. Let four pins be ſcrewed into the four corners of the bottom of the weight. Theſe pins muſt be two inches and a quarter in length, or as long as the meaſurer. Let two threads, or wires, be fixed to the extremities of theſe pins, one on the ſide next to No. 1, and the other on the oppoſite. No. 1, by bringing theſe wires into the ſame plane with the level flat top of the drift, and by letting it always fall when thus ſituated, will work the weight accurately without a meaſurer.

ON LAYING MORTARS.

THERE is not a more important part in the practice of artillery, than the laying of a mortar, in ſuch a manner that the ſhell may attain to its object with preciſion. If the plane, paſſing through the axis of the mortar and the centre of the ſhell, is not perfectly perpendicular to the plane of the horizon, the projectile will deviate to the right or left, from the line of the range. The object to be deſtroyed by the exploſion, or fall of the ſhell, ſhould be ſituated in this plane. The common mode of laying a mortar, is to find, by means of an inſtrument called a Perpendicular, two points, one on the muzzle reinforcing ring, and one on the breech-ring; both which points are ſuppoſed equally diſtant from the horizon, on either ſide. It is ſuppoſed, that a plane paſſing through theſe two points, is perpendicular to the horizontal plane. Previous to finding theſe points with a perpendicular, the centre line of the mortar,

and the object are, by the eye only directing, brought as nearly as poſſible into the ſame plane of coincidence. This precaution excludes a neceſſity that would ariſe of laying off freſh points with the perpendicular, or moving the mortar, in the ſmalleſt degree to the right or left, as the mortar would, in ſuch a caſe, (unleſs when on a very well laid platform) change its level of poſition. If the perpendicular with which theſe points were found, was true, and if the circumferences on which theſe points are ſituated, were true in regard to their centres, a plane paſſing through them would certainly be perpendicular to the horizon, would biſect the mortar and ſhell, and conſequently, ſuch a plane and the object being brought to coincide, the ſhell would be delivered with an axis over the range dividing it into two hemiſpheres, one to the right, and the other to the left. This ſituation of the ſhell would carry it, *cæteris paribus*, to its object without any conſiderable deviation. In the beſt conſtructed uſed mortars I have ever ſeen, the radii have ſeldom been perfectly equal, when compared to each other. They vary ſometimes as much as 1–10th of an inch. This affords a very ſtrong preſumption, that the other reinforcing rings are equally erroneous in reſpect of their centres. If we ſuppoſe one ring only (of thoſe uſed) to have its circumference unequally ſituated from its centre, the effect will be almoſt equally erroneous, as when both rings or circumferences have their radii unequal.

The perpendicular is an inſtrument well known to practical artilleriſts. It is preciſely, but with different means, on the ſame principle as a maſon's common level. The principle of it is, that when the air bubble is at reſt in the middle of the ſpirit-level tube, the extremities of the legs are equally diſtant from the bubble, and from oppoſite points in the plane of the level, at equal diſtances from the centre. This being its conſtruction, it follows, that a plane

drawn

drawn through the two points, or extremities of the legs, will be parallel to the horizon, and, conſequently, that when the air bubble is at reſt in the middle, the extremities of the legs are equally diſtant from the horizon. If the axis of the glaſs cylinder, containing the ſpirit and bubble, is not, when the inſtrument is conſtructed, made perfectly parallel to the line paſſing through the extremities of the legs, the perpendicular will be falſe. Suppoſing that the reinforcing rings of a mortar, form exact circles to their centres in the axis of the mortar, if the perpendicular is not conformable to the above deſcription, the plane paſſing through the two points given by it on the outſide of the mortar, will not paſs, as it ought, through the axis of the mortar, but will give a plane, which if the mortar is laid in, will make the ſhell deviate to the right or left, according to the degree of falſity in the inſtrument. If the plane of the level inclines to the left, that is, if the left leg is ſhorter than the right, the point given on the circumference will be to the right of the true axis point, and, conſequently, the ſhell will go to the left, and *vice verſa*. Again, ſuppoſing the perpendicular juſt, and the mortar not properly caſt, but having the circumference nearer the centre on the left than on the right ſide, in this caſe, the plane paſſing through the point given by the perpendicular, will not paſs through the centre of the ſhell and true axis of the mortar, but to the right of both, conſequently the ſhell muſt go to the left of the object it is laid at. Suppoſe the diſtance from the centre to the circumference farther from the centre, on the left, than on the right ſide, then the plane of direction will be given to the left of the real one, conſequently, the ſhell will go to the right. To render all theſe ſuppoſitions perfectly intelligible, we ſhall exemplify them by the projection of a figure.

See plate II. figs. 1, 2.

It may ſometimes happen that the errors on the muzzle and baſe rings, will be on oppoſite ſides; in which caſe, the ſhell will croſs over from one ſide of the range to the other. —If the errors were equally diſtant from the axis, on the circumference of both rings, the ſhell would go nearly in a parallel direction with the range, an effect that can ſeldom be expected from the improbability of ſuch a circumſtance.

Let A B C D repreſent a mortar, with its ſhell d e f g in it, ready to be fired off. If the mortar is laid in the line of its true axis, the ſhell will range in a true direction: but ſuppoſe that the reinforcing ring is not true in reference to its centre d, but that the metal ſwells from k to h, on the muzzle-ring, in the irregular form k m h, making the radius d m greater than the radius d h, in this caſe, if the perpendicular is true, it will give a falſe point, probably about t; and the mortar being laid in this line, viz. in the line r t u, the ſhell will go to the right of the range lying in the axis line I d H. If the breech-ring 1, 4, 6, was falſe in the ſame proportion, it is evident, that the line of direction of the mortar, being parallel to the axis, the ſhell would ſtill go to the right, and would deviate but little from the true line of direction, going in the line w x z.—If, in this caſe, a perpendicular was uſed, having its left leg ſhorter than its right, and if this ſhort leg were applied on the ſide k m t, it would increaſe the error, by throwing the line for directing the mortar ſtill farther towards m, and more remote from the centre than t. Such are the obvious conſequences when the metal projects beyond the true extremity of the radius.—We ſhall now ſuppoſe that it falls ſhort of it, viz. that the radius I 8 is ſhorter than the radius I n of the breech-ring. In this caſe, ſuppoſing the perpendicular true, the point given will be to the left of the real axis, probably about x, from which we have this concluſion, that when

the

the metal exceeds the length of the radius on one ſide, and falls ſhort of it on the other, the line of direction given by the perpendicular will be to the left of the mortar's axis; and, therefore, the ſhell will go to the right of the range. If, in this inſtance, the longer (ſuppoſed) leg of the perpendicular was applied to the falſe curve 4, 8, 6, and the other to the curve r n 1, one error would, very nearly, correct the other, giving the higheſt point r.—The mortar would be in the direction r t u, and would throw the ſhell to the right of the range, deviating from the line of direction from the point r.—From the delineation of theſe caſes, it will be eaſy to imagine all thoſe that can occur, and to make a neceſſary allowance for errors in the mortar or inſtrument.

Let 4, 5, 2, 3, fig. 2. repreſent a perpendicular, applied to the muzzle-ring of a mortar, as to a d c, ſuppoſed true; the bubble, when at reſt, will have its centre over the higheſt point of the curve, at d. It is alſo evident, from inſpection, that if the leg 4, 2, is ſhorter than the leg 5, 3, the inſtrument muſt be moved a little to the right, to have the bubble ſtill retained in its poſition. This defect in the perpendicular muſt give a falſe axis, to the right of the real one B A, and the ſame holds, *mutatis mutandis*.

Having thus very fully pointed out the cauſes of error that ariſe in laying mortars, whether proceeding from a falſe conſtruction of the perpendicular, or the inaccurate diſpoſition of the metal of the muzzle and breech rings of a mortar, we ſhall inſert a mode of finding the true axis independent of the uſe of the perpendicular, and by which a mortar may be directed with as great accuracy as when the viſual ray enters the eye in a line, having the object and rings in one and the ſame ſtraight line. This is an eſſential object to obtain, when it is conſidered, that from the cauſes of error detailed above, the effect of bombarding is

ſlow

ſlow and uncertain. It may be urged, that mortars may be caſt devoid of the defects enumerated. It is granted that they may: but the mixture of copper, tin, and a little zinc, forming not a very hard combination, will, in uſe and practice, frequently meet with rubs, ſhocks, or other accidents, which will produce defects. Let mortars that have been uſed, or frequently removed from one ſituation to another, be obſerved, and their rings will often be found indented, flattened, and deformed. Such are but ill calculated to give a true axis from the external application of inſtruments, which, probably inaccurate in their conſtruction, may increaſe the error.

Let a piece of hard wood, not liable to warp, and five inches thick, be fitted exactly to the bore of a mortar, rather entering it with ſome ſmall degree of difficulty. To prevent its wearing, its circumference may be neatly covered with ſheet copper, and two handles may be fixed on it, near the circumference. In the centre of the wood, a ſlender metal pin is ſcrewed, perpendicular to the ſurface. This pin muſt be of ſuch a length, as that at an angle of 70°, a perpendicular let fall from its extremity, may not reſt on the lower part of the circumference of the mouth of the mortar. 70° are mentioned as an angle ſeldom exceeded for any purpoſe; and indeed only uſed to give a ſhell greater momentum in deſtroying a building. The pin terminates in a point, to which is fixed a thread, having a $\frac{1}{2}$ pound weight at its extremity. This pin will be the axis of the mortar produced. The plane paſſing through the axis of the pin and the thread, muſt be perpendicular to the horizon, through the axis of the mortar; from which it follows, that if the mortar is moved a little to the right or left, till this plane is brought to bear on the object to be bombarded, the ſhell, ſuppoſing the action of the air on it uniform, will be delivered in a true line of range. Before the ſhell, with

a fuze in it, cut correſponding with the time of flight, is put into the mortar, it muſt be laid for the object. Let a perſon mark with chalk, the two points (one above and one below) on the edge of the mortar's circumference at the muzzle, and in the plane of the pin and line. Let an oblong plate of metal, 1–8th of an inch thick, and 6 inches broad, be provided. Let it be of ſuch a length as to extend from the bed of the mortar, along the chalk marks, beyond the upper part of the circumference. It muſt be placed on the chalk marks, preciſely at right angles to the plane of the mortar's mouth. For this purpoſe, it will have, on either ſide, above and below, pieces of braſs, an inch broad, and two long, fixed at right angles to its lower edge, where they are in contact with the thickneſs of metal of the mortar. Theſe lateral projections will ſupport it, ſteadily, on the chalk marks, in its poſition at right angles to the muzzle. The circular piece of wood, with its pin and pendant line, is removed to make way for the operation of placing the thin metal plate, called the "Sight Plate." It reſts on the mortar bed with its lower end. If the mortar is laid at a high angle, the lower end reſts on a piece of wood, ſuch as d b c. It is prevented from ſliding in this poſition, by placing a weight of a few ounces in front.

See plate II. fig. 3.

EXPLANATION.

a b, The plate of metal in the plane of the true range, ſupported by d c.

g f, The elevating ſcrew, having its axis in the plane of the range.

r s, The cylinder of wood, with the axis pin h u, and its line h n, with a weight n.

1 3, The viſual ray entering the eye through the ſight y, and in a plane 1 t h n, perpendicular to the horizon, and biſecting the bore of the mortar.

When

When this piece of metal is thus properly placed, it is evident that it lies inclined in a plane perpendicular to the horizon, and coinciding with the axis of the mortar. The upper end of the plate may have a ſight, conſiſting of a croſs hair and eye-hole adapted to it, ſuch as y. The mortar may be laid by the plane of the pin and thread bearing on the object, but ſtill more accurately by the ſight on the metal plate. If, on applying the metal plate, the axis of the mortar is found to be conſiderably out of the range, on moving it to the right or left, it will be neceſſary to aſcertain freſh chalk marks, as the lateral movement of the mortar may throw the former marks into an oblique direction with the horizon, from the variation of plane in different parts of the platform, ariſing either from original inaccuracy in laying it, or from concuſſion, proceeding from the action of the recoil. The above figure is a repreſentation, in ſection, of a mortar laid by the mode deſcribed.—The angle ought to be laid off, previous to laying the mortar; which laſt operation generally occaſions an alteration in the angle.—The final adjuſtment of the angle may probably alter the direction. This may follow from the croſs action of the handſpikes, made uſe of in elevating or depreſſing. The common mode is to croſs two handſpikes in front, and to bear on them till the mortar is raiſed, in order to puſh in, or draw out the quoin, as may be requiſite. The powers of the men at the handſpikes can ſeldom be equal; the conſequence of which will be, that the mortar will yield towards that ſide where there is the leaſt reſiſtance, occaſioning an alteration in the direction. A contrivance is, therefore, wanting, by which to give the angle without altering the direction. Small mortars may be elevated by means of ſcrews. The ſhock in large ones, has been found deſtructive of theſe ſcrews. It is not neceſſary that the ſcrew ſhould be attached to the metal and bed.

It

It may be a ſeparate inſtrument, and applied occaſionally to the mortar in the plane of the chalk marks. When thus uſed, it will elevate or depreſs the mortar without altering its direction. Its upper end muſt be ſhaped concentric with the circumference of the mortar, and its lower end muſt work in a ſhoe, prevented from ſliding by a picket driven into the ground. The power of the ſcrew being in proportion to the exceſs of the circle marked by the winch, in one revolution, over the diſtance between one ſpiral and another, it is evident, that labour is ſaved, as one man will have more power than is neceſſary for elevating the heavieſt mortar in uſe.

On The Gunner's Quadrant.

The caſe we have been ſtating, fully accounts for the deviations to be obſerved frequently in the projection of ſhells from mortars. From a varying ſtrength of the ſame quantity of powder, the range may vary. A difference in the extent of the range may proceed from an error in the quadrant; from an inaccurate application of it; from a falſe diſpoſition of the gun or mortar; or from combinations of theſe cauſes. If a few ſmall charges of powder are well dried, and put into a gun or mortar, laid perfectly horizontal, and occupying the ſame ſpace in it, the reſult will be, that the ball or ſhell, in repeated trials, will not vary materially in extent of range. Let the ſame piece of ordnance be elevated to an angle, with charges in all reſpects ſimilar, and it will be found, that though every poſſible degree of care may have been uſed in laying off the angle of elevation, the ranges will now differ materially. We ſhall now endeavour to ſhew how far this effect may be aſcribed to

the cauſes enumerated above. The gunner's quadrant is an uſeful inſtrument, well known to artilleriſts.

See plate II. fig. 4.

Let A B C repreſent a mortar inclined to the horizon B D, at an angle of 45°, viz. at the angle F g D, formed by the axis of the mortar F g, and the horizontal line B D. Let m F o repreſent the gunner's quadrant, applied to the axis F g. Let F n repreſent the index of the quadrant, making an angle of 45° degrees with the axis F g. It is evident, that if the line F g, with the index F n (now repreſented by F m) in cloſe contact with it, is brought to coincide with the horizontal line g D, the air bubble in the glaſs tube on the index will not aſſume its poſition of reſt in the middle of the tube, till the lines F g and g D coincide, conſequently, the line g D, and the index line F n, are parallel and horizontal.—Again, becauſe g D is parallel to F n, the axis F g will be a diagonal to them, and therefore, the angle F g D, formed by the mortar with the horizon, is equal to the angle m F n, intercepted between F n, the index having the air bubble at reſt on the middle of it, and the limb of the quadrant F m applied to F g, the axis of the mortar. In laying mortars to their angles of inclination, the inſide is ſuppoſed to have been bored parallel to the axis, that is, F g is ſuppoſed parallel to a b. The bore may not be a cylinder. If it is, from uſe or otherwiſe, wider at the muzzle than towards the chamber, the angle of elevation given by the quadrant will be leſs than that at which the mortar actually ſtands. The contrary of this takes place when the bore is narrower at the mouth than farther in.—Let b k repreſent the ſide of the vacant cylinder, perfectly parallel to the axis F g, if there is no fault in the quadrant, and it is applied to the two loweſt points of the inſide, on the line b k, it will indicate the real angle of inclination.

clination. Again, let b r repreſent the line of metal, or the inſide not parallel to the axis F g, it is evident, that the index of the quadrant will be nearer m on the limb of it, than when the line b r coincides with the line b k; for, if the quadrant is ſuppoſed applied to b r, and b r is ſuppoſed depreſſed to b k, the equilibrium of the air bubble being deſtroyed, it will aſcend to the higher end of the tube containing it, and, therefore, to reſtore this equilibrium, the index of the quadrant muſt be raiſed higher on the limb, giving a greater angle than when the leg of the quadrant is applied on b r. The oppoſite degree of reaſoning to this holds, when the line of metal b r is on the other ſide of the line b k parallel to the axis F g, that is, when the mortar is wider within than at the mouth. A falſity in the conſtruction of the quadrant itſelf, may occaſion an error in the angle of inclination. Suppoſe, for inſtance, that the limb of the quadrant is a little bent outwards, in the plane of the limb, as m f u, it is obvious, that the angle will be given leſs than the truth; and the contrary effect will happen when the leg is bent ſomewhat in the oppoſite direction. The angle at which a mortar is inclined may be taken with a true quadrant in any part of the bore, provided that the long leg of the quadrant is applied in coincidence with the braſs of the inſide, in a line parallel to the plane, perpendicular to the horizon paſſing through the axis of the mortar. It frequently happens from the inattention of young artilleriſts, that though both quadrant and mortar may be reſpectively true, ſtill the angle is falſely taken. This happens when the plane of the quadrant forms an angle with, or lies oblique to, the above plane. Let it be ſuppoſed, for inſtance, that the two loweſt points on the inſide of a mortar are found by the perpendicular, and that the leg of the inſtrument is applied to theſe points, it is manifeſt, that if the mortar is truly bored, and the perpendicular is juſt, the

angle

angle will be correctly given by the limb; but if the end of the leg is in the leaſt degree ſhifted to either ſide, the air bubble will aſcend to the raiſed end of the glaſs tube, and muſt be lowered on the limb, to reſtore the equilibrium. This depreſſion of the index diminiſhes the angle below what it was when the quadrant was properly and juſtly placed in the mortar. A very exact mode of laying off, or taking the angle of elevation, will be, to apply the leg of the quadrant to the axis pin, mentioned heretofore; as no method of effecting this can be truer than making uſe of the axis itſelf.

ABSTRACT

(To face page 54.)

ABSTRACT of CASES worked from real Experi
the THEORY of ARTILLERY with the PRA

10 INCH MORT

PRACTICE.

	Charge, pounds.	Elevation.	A medium range in yards.	Time of flight in seconds. *per* pendulum.	Time of flight in seconds. *per* calculation.	Weight of shell.	Sand in shell.	Weight of shell and sand.
1		45°	487	10	$9\frac{3}{4}$	91	2 10 4	93 10 4
2		45	1104	15	14	do	do	do
$1\frac{1}{4}$		45	782	$13\frac{1}{2}$	$12\frac{1}{2}$	do	do	do
$2\frac{1}{4}$		45	1350	18	16	do	do	do

The calculations were made on the parabolic hypothesis, and the results might be affected by inaccuracies in the platform, mortars, and instruments made use of. The index of the quadrant, particularly, had a loose, unsteady motion round its centre.

$5\frac{1}{2}$ INCH ROYA

PRACTICE.

	Charge, ounces.	Elevation.	A medium range in yards.	Time of flight in seconds. *per* pendulum.	Time of flight in seconds. *per* calculation	Weight of shell.	Sand in shell.	Weight of shell and sand.
1		45°	51	3	$2\frac{1}{2}$	14 14	$ 10 10	15 8 10
2		45	90	$4\frac{1}{2}$	4	do	do	do
3		45	170	6	$5\frac{3}{4}$	do	do	do
4		45	320	$8\frac{1}{2}$	8	do	do	do
5		45	428	10	$9\frac{1}{2}$	do	do	do
6		45	624	12	11	do	do	do
7		45	786	$14\frac{1}{2}$	16	do	do	do
8		45	800	17	19	do	do	do
9		45	1140	19	$18\frac{1}{2}$	do	do	do

l Experiments, with a view of Comparing
the PRACTICE.

MORTAR.

form, mortars, and inſtruments made uſe of. The index of the quadrant, particularly, had a looſe, unſteady motion round its centre.

PRACTICE and THEORY Compared.

Elevation.	Meaſured range.	Calculated range.	Range in yards.	*per* pendulum.	*per* calculation.	Time of flight in ſeconds.	Difference of meaſured and calculated ranges.	Diff. of time of flight *per* pendulum & calculation.
60° 12″	372	420		12	12		48	
57 30	1013	1001		19½	18		12	1½
57 46	620	705		14½	14		85	
59 30	1159	1181		21	20		22	1

ROYAL.

PRACTICE and THEORY Compared.

Elevation.	Meaſured range.	Calculated range.	Range in yards.	*per* pendulum.	*per* calculation.	Time of flight in ſeconds.	Difference of meaſured and calculated ranges.	Diff. of time of flight *per* pendulum & calculation.
53° 45″	44	48		4	3⅛		4	
38	88	88		4¼	4			
38 26	156	165		5½	5		9	
39 45	270	313		7	7⅛		43	
40 45	406	423		9	8½		17	
51 45	596	585		13	12		11	1
54 19	700	745		16	15⅛		35	1⅛
60 15	765	689		loſt	20		76	
24 6	850				9¾			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RANGES and TIMES of FLIGHT of a 13 Inch SHELL at 45°.

Pounds of Powder.	Medium range.	Time of flight *per* pendulum.	Flight by calculation.	Difference.	Sand in shell.	Weight of shell.	Weight of sand and shell.
1	78	loſt	2		6 10 10	200	206 10 10
2	393	loſt	8½				
3	704	13	12	1	– Do. –	–Do.	— Do. —
4	1020	15	14	1			
5	1312	17	16	1			
6	1506	18	16¾	1¼			
1½	142	5	3	2			

It has been aſſerted by a reſpectable author, and, from his ſubſequent reaſoning, it is underſtood he means an angle above 45°, that the angle giving the greateſt horizontal range lies between 40° * and 50°. If this is a fact, and if the above experiments had been made at 47° 30″, it is probable, that the calculated and meaſured ranges, as alſo the times of flight, would have coincided ſtill nearer. A probable cauſe may be aſſigned for the exceſs of the range at a few degrees above 45° over that at 45° †. The

* See D'Antoni's Treatiſe on Gun-powder, p. 226.

† After writing this paragraph, I had an opportunity of looking over the article "Projectiles," neatly drawn up, and conveying much new information on this ſubject, in the Encyclopædia Britannica. It is there ſtated, that though the greateſt horizontal range ſhould be at 45°, yet it is always found to be much lower. As this concluſion is founded on experiment, we muſt ſuppoſe the Italian author's aſſertions to be unfounded. The little that is here ſaid on them, is written on a ſuppoſition of their truth.

The higher the mortar is elevated, the leſs will be the recoil, and action and reaction being equal, the projectile will be impelled forward with a part of the force which, at a lower angle, would act in the direction of the recoil. It is a well known fact, that a part of the charge is ejected uninflamed, proceeding from a want of ſufficient reſiſtance oppoſed on the ſide neareſt to the muzzle of the piece. There is certainly very reſpectable authority for ſuppoſing the inflammation inſtantaneous, or, as Mr Robins expreſſes it, "That the whole of the charge of a piece of ordnance is "actually inflamed, and converted into an elaſtic vapour, "before the bullet is ſenſibly moved from its place." Count Rumford's experiments, to determine the force of the elaſtic vapour generated by gun-powder, confute this aſſertion. The Count, with an apparatus very ingeniouſly conſtructed, raiſed a twenty-four pounder, weighing 8081 lbs. avoirdupois, with 18 grains of powder confined, and neceſſarily all inflamed; from which he deduces, that the expanſive force of the generated elaſtic fluid produced by inflamed gun-powder is more than fifty thouſand times the mean preſſure of the atmoſphere. It may therefore be concluded, that by much the greateſt part of charges of powder eſcapes uninflamed. Shells are found to range farther at an angle of 70° than at an angle of 20° *. This militates againſt the commonly received opinion, that equal diſtances on either ſide of 45° will give ſimilar ranges †. The real fact we ſuppoſe to be, that the recoil at the higher angle acting in a forward direction, in proportion to the check, and the ſhell, at the ſame time, reſiſting the action of the powder more

* See D'Antoni's Treatiſe, p. 224.

† By uſing different charges of powder, it will be found that there is a particular correſponding elevation, affording a greater range than any other. From this it would appear, that fixing the mortars in their beds is a practice that ought to be avoided.

more forcibly as it approaches the perpendicular, time is afforded for the generation of a greater quantity of fluid than would at the lower angle be produced before the projectile quitted the mortar, the conſequence of which muſt be, a greater range at the higher than at the lower angle, as the additional fluid produced operates more forcibly in proportion than the ſhell reſiſts. An increaſe of elevation of mortars has been found to increaſe the initial velocity, when the charges were equal. This does not take place reſpecting muſkets, particularly when the object and muſket are in the ſame horizontal plane. A rifled carabine bullet, having an initial velocity of 1956 feet, ranged, at 15°, 901; at 24° 20′, 938; and at 45°, 895 yards only. The greateſt range of a muſket will be modified by its direction, by the diameter and denſity of the ball, by the denſity of the air, and by the difference there may be between the horizontal planes of the object and muſket. The maximum of range diminiſhes at a few degrees above 45°, and the reaſons ſtated will probably account for its not being preciſely at the middle angle. The experiments were made as follows: For inſtance, a $5\frac{1}{2}$ inch royal was put at an angle of 45° with one ounce of powder. The range was found, and alſo the time of flight, by a pendulum, 39. 1 from the point of ſuſpenſion to the centre of the ball. This pendulum vibrated ſeconds. A few experiments of this kind were made, which afforded a medium range. With the ſame quantity of powder, any other angle was uſed. Its range and time of flight were meaſured, and alſo calculated, and the difference between the meaſured and calculated ranges and times of flight, is inſerted in the 6th and 7th columns. The powder uſed was not of a very equal quality. The platform had been a good deal ſhook by much previous practice, and the quadrant made uſe of was not perfectly accurate. The ſhells alſo had (a cauſe of error but too frequent) too much windage.

From

From theſe cauſes, the reſult is not ſo accurate as it might otherwiſe have been.

A Propoſed Mode of making a SHELL Explode on coming in contact with the Ground.

SUPPOSING that fuzes were rendered uniform in their times of burning; that mortars and guns had no errors of metal on the in or outſide; and that inſtruments made uſe of were perfectly accurate in their conſtruction; ſtill the varying ſtrength of the ſame quantity of powder will occaſion a difference in the time of flight, that will produce an inaccurate exploſion of the ſhell. Let us ſuppoſe, for inſtance, that the time of flight given by a certain quantity of powder is 20 ſeconds. If the next charge ſhould be of a ſtronger quality, the time of flight will be increaſed, the conſequence of which will be, that the ſhell will explode before it arrives at the object to be deſtroyed. Let us ſuppoſe, again, that the third charge will be of a weaker quality; in this caſe, the time of flight will be leſs, and the fuze being cut on a ſuppoſition of uniformity in the action of the powder, the ſhell will neceſſarily be buried in the ground before it explodes. This makes it obvious, that a contrivance is wanting that will make a ſhell burſt at the inſtant of touching the ground. The following propoſed mode has not as yet been brought to the teſt of experiment, but all to whom it has been explained ſeem to think that it will be ſucceſsful.

See plate II. figs. 5, 6, 7.

Let 1, 2, 3, 4, 5, repreſent a ſhell at the inſtant of its touching the ground, after falling through the laſt part of its deſcribed curve B C.

a b, repreſents an empty cylinder of iron, one ſide of which projects beyond the ſhell to c, and the end, a b, is drawn firmly into the empty fuze R, driven into the fuze-hole, and the cylinder a b, a b, coincides with, and fills up, exactly, the empty ſpace 1, 1, 1, 1, when the ſhell is ready for delivery.

The ſhell, 1, 2, 3, 4, 5, has its greateſt thickneſs of metal on the fuze-hole ſide, which by the action of gravity will, in deſcending, be neareſt to the ground.

The cylinder a b is $\frac{1}{10}$ of an inch in thickneſs; and is charged with a ſlow burning fuze compoſition, driven into it by means of a drift, of which 13, 14, in figure, is a ſection.

The cylinder charged with compoſition, exactly fits the empty cylinder of the fuze, into which it is drawn firmly before the ſhell is diſcharged.

g h, is a piece of wood fixed on the projecting ſhank of the cylinder, by a few turns of a male and female ſcrew, and its uſe is, on ſtriking againſt the ground, to diſlodge the cylinder a b from the empty fuze 1, 1; for unleſs this piece of wood was fixed on c c, the projecting ſhank of the cylinder, it would enter the ground, from being ſharp, without diſlodging the charged cylinder, and, conſequently, the intended effect would be loſt.

The thickneſs of metal at 6, 4, 6, 3, ſhould be to the thickneſs of metal on the oppoſite ſide, rather more than as 2 to 1, in order that the fuze-hole ſide may come firſt to the ground, on which the whole ſucceſs of the invention depends.

The exploſion of the powder in the chamber of the mortar will inflame the compoſition in the cylinder, and a few ſtrands of quick-match may be tied round the ſhank of the projecting ſide of the cylinder, to enſure the communication

of the flame to the loose powder in the bowl of the fuze, and, consequently, to the composition in the cylinder.

The shank of the projecting side of the cylinder is tied firmly, with a piece of packthread, to the neck of the fuze, as represented at 4, 7, 3. The packthread, thus tied, prevents the end a b of the cylinder from being dislodged from the end 1, 1, of the fuze, by the shock of the explosion in the discharge of the shell from the mortar. Tying the projecting shank thus to the fuze, will not impede the effect to be produced by the invention, as the burning of the composition in the cylinder will consume the packthread in a few moments after the shell has been delivered, and after the thread has answered the purpose for which it was intended.

Previous to putting the loose mealed powder into the bowl of the fuze, in order to catch fire and inflame the composition, a little soap or putty should be pressed between the cylinder and inside of the fuze, should they not coincide exactly. After the fuze is driven, the cylinder may be drawn into it and fixed, or it may be drawn into its place in the fuze, before the fuze is driven. The soap or putty, pressed between the cylinder and the fuze, prevents the scoriæ, arising from the burning of the composition, from communicating with the powder in the shell, by passing to it between the cylinder and the inside of the fuze. The inside of the bottom of the fuze, and the outside of the bottom of the cylinder, might be adapted to each other by a single turn of a male and female screw. This single turn would yield to the action of the stroke against the ground, and would prevent the possibility of the entrance of scoriæ into the shell. This simple apparatus being thus adjusted, the shell is discharged. On arriving at the vertex of its curve, the action of gravity will destroy the rotatory motion round the axis, and incline the fuze-hole side towards the ground. The ball g h, fixed

on

on the ſhank of the cylinder projecting beyond the ſhell, on meeting with reſiſtance from the ground, at 12, 12, will impel the inflamed cylinder into the empty ſpace of the ſhell, and the charge of powder in the ſhell will be exploded, and burſt it in contact with the ground. The figure repreſents the ſhell at the ground, with the cylinder driven into it, by the ſtroke on the projecting ſhank againſt the ground. The cylinder is perforated full of ſmall holes, that the flame may emit itſelf through them, and act the more readily on the powder in the ſhell.—The ball on the ſhank may be leſs than that in the figure. 9, 10, a ſection of a ſetter for driving the fuze, after the cylinder is drawn into it. 13, 14, a ſection of a compoſition-driver, tipped with copper, for driving and fixing the compoſition in the cylinder.

See plate II. fig. 5, 6, 7.

Shells might probably be made to burſt on water, by ſubſtituting a flat board, 3 or 4 inches in diameter, in lieu of the ball fixed on the projecting ſhank.

Such is this ſimple contrivance, calculated to obviate the inaccuracy in the exploſion of ſhells, ariſing from the unequal ſtrength of powder principally, and, in ſome degree, from the other cauſes of error enumerated.

THE following uſeful inſtrument has been ſuggeſted by Alexander Irving, Eſq; Advocate, and Firſt Lieutenant in the Company. His own deſcription and delineation of it are as follow:

See plate II. fig. 8.

Breadth of the aperture 1 inch, length 1. 5, which is divided by a ſcale into 18 parts, each of which, when the length

length of gun * is made radius, will be equal to 5 minutes. The nonius dividing plate, which is fixed to the horizontal moveable wire, being divided into 5 parts, which, altogether, are equal to 4 diviſions of the ſcale, will give a diviſion into minutes.

The two feet of the inſtrument reſt upon the upper part of one of the muzzle mouldings of the gun, on which it is kept by a ſteel ſpring. The ſpirit-level muſt be parallel to a line joining the feet, and at right angles to the vertical wire.

The view of the back of the inſtrument will ſhew the mode in which the nonius and horizontal wire is raiſed and lowered, by means of a ſcrew.

The aperture is biſected vertically by a black wire, which is cut at right angles by the horizontal one. The latter, however, muſt not be a wire, but a thin plate, ſet edge-ways, that it may bear being raiſed and lowered. When it arrives at the oppoſite ſide of the inſtrument, it is flattened in the contrary direction, and kept cloſe to the limb of the inſtrument by a ſlip of metal, which, however, allows it to move freely up and down.

We ſhall now deſcribe the mode of applying it.

It often happens, when the object aimed at is near, and when it is even as far off as 400 yards, that (though the real angle in the latter caſe may amount to half a degree) the line of metal, or the viſual line, may terminate on the ground, ſhort of the object, in order that it may be hit and deſtroyed. In this caſe, the gun is ſaid to carry high. Again, it may happen, that in order, with another gun, to hit the ſame object, it will be found neceſſary to lay the gun above the object. In this caſe, the gun is ſaid to carry low. If the ſhots, in both caſes, are ſuppoſed to hit the object aimed at, theſe reſpective guns ſhould be pointed in the ſame manner,

* This calculation can only apply to the ordinary light ſix pounder.

manner, to be equally ſucceſsful in ſucceeding ſhots. A quadrant will certainly effect this; but this inſtrument may not be always in readineſs, and time often cannot be ſpared for its accurate application. Without a quadrant, or ſome other inſtrument, it will be uncertain whether the guns are or are not pointed preciſely in the ſame manner, when the viſual ray or line does not bear on the object. The inſtrument invented by Mr Irving obviates this difficulty, as the horizontal wire can be depreſſed or elevated, till its interſection with the perpendicular one cuts ſome point on the object, and by bringing the interſecting point on the ſame part of the object in all ſucceeding ſhots, the gun will always be ſimilarly pointed, and the effect, *cæteris paribus*, adequate. The angle of elevation of field-pieces ſeldom exceeding a degree and a half in field uſe, the inſtrument is capable of aſcertaining that quantity, and might be rendered capable of comprehending a greater angle, by being made higher.

If, when the gun is laid level, the nonius is brought to 60″ on the ſcale, the line paſſing from the object over the wire to the eye, will be parallel to the axis of a ſix-pounder, to which the inſtrument is adapted.—The angle, therefore, may be taken or laid off, by reckoning from 60″ as an initial point, when the elevation or depreſſion of the horizontal wire, brought to cut the object, marks exactly that of the gun. The eſſential uſe of this inſtrument, however, is to aſcertain accurately what the eye alone could not effect, viz. ‘ that guns, where a repetition of effect is wanted, ſhall “ be pointed preciſely in the ſame manner.”

APPEN-

APPENDIX.

ON THE SERVICE OF ARTILLERY IN THE FIELD.

GUNS are not to be advanced loaded; and on giving the word "Load," the gun is to be untrucked.

When a gun is moving on at a quick rate, previous to halting, the word "Slow March," is to be given, to retard gradually the velocity, and thus prevent the dragrope men from being hurt.

The portfires are cut out when the guns are advanced or retreated in quick time. When in ſlow time, they may remain lighted.

When a ſpunge is wetted, it muſt be put into the ſpunge cap, in order to ſqueeze the water equally over its circumference.

He who ſerves the vent muſt wet his thumb-ſtall in ſome degree, and try the vent with a wire; the gun muſt then be tried with a wadhook, and immediately afterwards ſpunged out.

Attached to a LIGHT SIX-POUNDER.

Right Side-Box.

Shot fixed to powder,	
Round, - - -	8
Caſe, - - -	8
Tube-boxes of 90 tubes, - -	2
Portfires,	

Portfires, - - - - 8
Portfire-ſticks, - - - 2

Left Side-Box.

Shot fixed to powder,
Round, - - 8
Caſe, - - - 8
Portfires, - - - 8
Tacks for repairing ſpunges, - - 100
Spare waſhers, - - 2
Lynch-pins, - - - 2
Wires, - - - 2
A tarred marlin, - - 1

For Two Guns.

Pincers, - - 1
Chiſel, - - 1
Knife, - - 1
Sciſſars, - - 1
Marlinſpike, - - 1

Locker under the Gun.

Vent-punches, - - 3
Claw hammer, - - 1
Spring-ſpikes, - - 1
Common ditto, - - 1

Fore Limber-Box.

Shot fixed to powder,
Round, - - 6
Caſe, - - - 6
Flannel cartridges of ſorts.
Slow-match,—a roll.

Hind Limber-Box.

Shot fixed to powder,
Round, - - 6
Caſe, - - 6

Flannel

Flannel cartridges of different ſizes,
Portfires, - - - 30
A ſheepſkin,
Cartouches of leather, - - 2

Locker under the Limber.

A quantity of rope,
Blocks ſecured with iron, and of a middling ſize, 4

Behind the Axletree.

Spades, - - - 2
Pick-axe, - - - 1
Hand-bill, - - - 1
Felling-axe, - - - 1
Leather bucket ſuſpended from the breaſt tranſom.
A ſet of mens harneſs is attached under the carriage.
A ſet of dragropes is carried on the limber, and another under the limber.

Side-Arms.

Right ſide of the Gun.

Spunges, - - - 2
Ladles, - - - 1

Left Side.

Traverſing handſpike, - - 1
Crooked ditto, - - 1
Wadhook, - - - 1

Between the Cheeks.

Fork levers, - - 2
Linſtock on the left cheek.

Tackles.

Ropes for laſhing on the various articles.

Intrenching Tools.

Of ſorts, - - 2
Fixed to the axletree.

Drums in the Field.

To advance, - -	Tap.
To begin firing, -	Preparative.
To ceale firing, -	General.
To change round, - -	Short roll.
To retreat,	
Flam, - -	Unhook,
Long roll, - -	Limber up.

RANGES of a LIGHT SIX-POUNDER with Round.

Weight of Powder.		Elevation.		Range firſt Graze.
Lbs.	Oz.	Deg.	Min	Yards.
		0°	15″	449
		0	45	556
		1	00	649
1	8	1	15	709
		1	30	755
		1	45	836
		2	00	950

N. B. Medium range inſerted, between reſults in Europe and India.

Practice

No I.

Practice with a $5\frac{1}{2}$ Inch Howitzer.

Recoil. Ft.	Recoil. In.	Length of Fuze. Inch.	Weight of Powder. lb.	oz.	dr.	Elevation. Deg.	Grazes. 1st. Yds	Grazes. 2d. Yds.	Extreme Range. Yds.	Remarks.
						P. B.	61	129	560	
						$\frac{1}{2}$	76	170	614	
		2	0	8	0	$\frac{3}{4}$	90	281	606	Fuze burnt
						$1\frac{1}{2}$	101	300	897	at 550 yds.
						2	182	500	842	Fuze burnt
						P. B.	95	316	740	at 380 yds.
		$2\frac{5}{10}$				$1\frac{1}{4}$	210	285	770	
						$1\frac{3}{4}$	254	390	872	
						2	230	378	780	
		3				$2\frac{1}{2}$	310	409	950	
			0	12	0	$2\frac{1}{2}$	250	365	820	
						$3\frac{1}{4}$	285	400	785	
1	2					$3\frac{1}{2}$	278	475	820	
1	$2\frac{1}{2}$	$3\frac{6}{10}$				4	360	500	908	
1	$11\frac{1}{2}$					$4\frac{1}{2}$	346	500	800	
1	9					$4\frac{1}{2}$	390	540	917	
2	4		0	13	0	$4\frac{1}{2}$	335	482	900	
2	5					$4\frac{1}{2}$	500	580	870	
1	6						490	665	850	
1	$2\frac{1}{2}$						394	490	708	
1	0	$3\frac{5}{10}$	0	12	0	5	350	432	790	
1	$2\frac{1}{2}$						290	500	690	
1	$0\frac{1}{2}$						437	680	750	
1	7						370	530	790	
2	3		0	13	0	$5\frac{1}{2}$	580	650	890	

P. B. means point blank.

Howitzer Practice continued.

Recoil.		Length of Fuze.	Weight of Powder.			Elevation.	Grazes.		Extreme Range.	
							1st.	2d.		
Ft.	In.	Inch.	lb.	oz.	dr.	De	Yds.	Yds.	Yds.	Remarks.
2	0						480	617	740	
1	10					$5\frac{1}{2}$	491	623	810	
1	$3\frac{1}{2}$						410	642	890	
1	$5\frac{1}{2}$		0	12	0		397	610	935	
1	$4\frac{1}{4}$					$4\frac{1}{2}$	310	580	670	
1	0						400	550	910	
2	3					6	700	850		Shells
2	4						520	640		loſt
2	6					5	445	543	1110	
2	7					P. B	200	320	900	
2	6					Do.	350	433	920	
2	8	2	1	0	0		323	408	860	
4	8	0				$\frac{1}{2}$	250	380	1060	
3	11						150	270	950	
2	$4\frac{1}{2}$					1	300	420	800	
2	8						230	420	660	
2	10					$1\frac{1}{2}$	160	240	920	
2	2						640	675	890	
2	5					12	593	645	700	
2	2						360	610	730	
1	4		0	12	0	5	335	455	780	
1	5							550	740	
1	4					2	200	360	670	
1	5						152	300	710	

Howitzer

Howitzer Practice Continued.

Recoil. Ft.	Recoil. In.	Length of Fuze. Inch.	Weight of Powder. lb.	oz.	dr.	Elevation. Deg	Grazes. 1st. Yds.	2d. Yds.	3d. Yds.	Extreme Range. Yards.
4	3					2	510	980	1070	1175
4	5						520	980	1060	1150
4	5	2					620	860	930	1400
4	0		1	8	0	5	550	720	778	
3	11						1006	1095	1200	1390
4	2					12	1630	1680		1850
6	2						680	760	840	1650
6	4					2	662	855	1160	1499
8	0						820	840	970	Shell broke
7	6	$2\frac{5}{10}$				5	1160	Shell	loſt	
7	4		2	4	0		1130	1397	1540	
7	6						1708			1708
7	8					12	1720			1720
7	1						1730			1730
4	6						Shell	loſt		
3	6		1	8	0	2	390	560	700	1270
3	8						410	602	830	1230
2	1					P. B.	105	490	610	807
2	$2\frac{1}{4}$						129	403	485	940
2	2					$\frac{1}{4}$	110	400	530	660
2	3					$\frac{1}{2}$	230	270	473	820
2	2					$\frac{3}{4}$	140	220	360	840
2	3		1	0	0	1	170	220	418	1050
2	6					$1\frac{1}{4}$	300	480	615	920
2	8	2				$1\frac{1}{2}$	320	419	595	920
2	0						381	527	671	1000
2	0					2	383	516		1010
2	3						227	310	404	999
3	6						480	Thro' the Target and in Butt.		
3	8		1	8	0	$2\frac{1}{4}$	500	700	Shell	loſt
3	6						270	470	620	980
4	0					$2\frac{1}{2}$	360	470	640	960
3	6		1	0	0	$2\frac{3}{4}$	420	480	720	810
2	8					3	310	480	600	1070

Howitzer

Howizter Practice Continued.

Length of Fuze.	Elevation.	Weight of Powder. Heavy 5½ Inch Howit.	Weight of Powder. Light 5½ Inch Howit.	Grazes. 1st.	Grazes. 2d.	Grazes. 3d.	Extreme Range.
Inch.	Deg.	lb. oz. dr.	lb. oz. dr.	Yds.	Yds.	Yds.	Yds.
	3¼			300	420	592	850
	3½			350	424	562	loſt
	3¾			490	665	837	905
	4			431	640	720	920
	4¼			582	730	870	1002
	4½			546	597	728	1000
	4¾			530	532	620	1140
2	5	1 0 0		502	506	830	900
	5¼			480	530	680	1160
	5½			560	750	810	960
	5¾			760	800	920	1150
	6			810	970	1010	1030
	6¼			557	850	870	1060
	6½			470	650	755	loſt
	6¾			695	860	930	
1	2		0 5 8	120	250	340	500
2 5/10	6	1 0 0		620	850	920	loſt
9/10	2		0 5 8	120	240	310	420
2 7/10	7	1 0 0		860	1010	1040	1100
1 2/10	5		0 5 8	335	380	440	1340
2	2	2 0 0		315	673	850	loſt
1 1/10	5		0 5 8	228	376	400	510
1 9/10	2	2 0 0		410	670	1030	1440
1 3/10	12		0 5 8	550	615	640	680

Howitzer Practice Continued.

Length of Fuze.	Elevation.	Weight of Powder. Heavy 5½ Inch Howit.	Weight of Powder. Light 5½ Inch Howit.	Grazes. 1ſt	Grazes. d.	Grazes. 3d	Extreme Range.
Inch.	Deg	lb. oz. dr.	lb. oz. dr.	Yds.	Yds.	Yds	Y s.
2	3	2 0 0		790	870	1150	loſt.
1 1/10	12		0 5 8	495			loſt.
2 2/10	4	2 0 0		770	890	960	1420
1 2/10	2		0 8 0	290	400		1500
2 3/10	5	2 0 0		990	1000	1300	1580
1	2		0 8 0	227	380	500	740
1 8/10	1½	2 0 0		380	550	780	1340
1 2/10	5		0 8 0	320	390	420	760
1 6/10	1	2 0 0		320	500	790	ſh. br.
1	5		0 8 0	440	590	670	880
1 3/10	½	2 0 0		not	fired		
1 3/10	½	2 0 0		480	618	700	1240
1 3/10	12		0 8 0	800	880	930	930
1	P. B	2 0 0		2 5	700	830	1500
1 3/10	12		0 8 0	760	770	790	790
2	2½	2 0 0		714	880	1030	1430
1 5/10	2		0 11 0	318	400	510	880
1 7/10	3	2 0 0		630	840	920	1450
1 5/10	2		0 11 0	400	655	890	1025
1 6/10	3½	2 0 0		925	1040	1200	1657
2	5		0 11 0	670	830	970	loſt.
1 6/10	4	2 0 0		815	840	920	1520
2	5		0 11 0	500	768	790	800
1 6/10	4½	2 0 0		1050	1190	1290	1590
1 6/10	12		0 11 0	960	1050	1070	1090
2 2/10	5½	2 0 0		990	1150		loſt.
1 6/10	12		0 11 0	990	1070		1110
2 3/10	½	2 0 0		550	1140		1500
2	2		1 0 0	380	410		1150
1 8/10	5	1 0 0		580	670		loſt.
1 8/10	5		1 0 0	1025	1200		1590
2	½	3 0 0		250	810		broke.
1 8/10	5		1 0 0	300	530		1020

Howitzer Practice Continued.

Length of Fuze.	Elevation.	Weight of Powder, and Nature.		Grazes.			Extreme Range.
		Heavy $5\frac{1}{2}$ Inch Howit.	Light $5\frac{1}{2}$ Inch Howit.	1st.	2d.	3d.	
Inches.	Deg.	lb. oz. dr.	lb. oz. dr.	Yds	Yds	Yds.	Yds.
2	4	1 0 0		480	700	890	1420
	$2\frac{1}{2}$	2 0 0		670	880	1020	1480
	3		1 0 0	470	760	890	1040
	$2\frac{1}{2}$	3 0 0		620	878	1550	1550
$2\frac{4}{10}$	5		1 0 0	670	867	1060	1390
	3	3 0 0		1050	1111	1260	1590
	$5\frac{1}{2}$		1 0 0	1060	1090	1200	1400
$2\frac{6}{10}$	4	1 0 0		478	740	810	1000
	$2\frac{1}{2}$		0 11 0	350	490	600	800
$2\frac{4}{10}$	$4\frac{1}{4}$	1 0 0		540	580	780	1020
	$2\frac{3}{4}$		0 11 0	425	810	820	820
$1\frac{6}{10}$	$3\frac{1}{2}$	2 0 0		700	870	970	1300
$1\frac{5}{10}$	2		0 11 0	340	580	780	1200
$1\frac{9}{10}$	3	3 0 0		880	1000	1400	1770
	$4\frac{3}{4}$		1 0 0	625	890	100	1300
$1\frac{3}{10}$	$5\frac{1}{2}$	0 8 0		340	420		500
	$5\frac{1}{2}$		0 8 0	425	600		800
$1\frac{4}{10}$	3	0 11 0		350	470		920
	3		0 11 0	410	500		990
$1\frac{8}{10}$	7	1 0 0		740	930		1100
	7		1 0 0	920	1060		1440
2	8	1 2 15		870	1070		1350
	8		1 0 0	1035			1499

No.

No. II.

EXPERIMENT with a SIX-POUNDER, Middling Field-Service GUN.

Recoil. Ft.	Recoil. In.	Elevation. Deg.	Weight of Powder. lb.	oz.	d.	Shot Grazed. 1st. Yds.	2d. Yds.	3d. Yds.	Extreme Range. Yards.
8	4	P. B.				200	500	740	
4	7	0 1/2				409	720	850	
4	11	0 1/4 D.							
4	7 1/2	0 1/2 D.				160	403	598	
4	8	0 1/4 E.				170	360	730	
4	7	P. B.				220	560	877	
4	5 1/2	0 1/4 E.				38	690	1120	
4	6	P. B.				365	1010	1040	
4	7					269	645	890	
7	0	0 1/4 E.				351	650	870	1475
5	4	0 1/4 D.				400	560	790	
5	6 1/2	P. B.	1	8	0	360	710	960	
4	10	0 1/4 E.				300	650	960	
4	5	0 1/4				410	900	1230	
5	4	0 1/2				415	670	700	
5	8	0 1/2				450	790		
7	7	0 3/4				495	770	1106	
6	7	1				640	990	1100	
5	10	1 1/4				703	790	990	
5	8	1 1/2				615	715	950	
6	0	1 3/4				880	920	1010	
7	9	2				704	970	1007	1400
7	9	2 1/4				850	1190		2000
5	9	2 1/2				900	1180	1180	
5	7	2 3/4				985	1160	1230	1750
5	8	3				930	1130	1240	

N. B. We have inſerted practice and experiments in Europe, in preference to thoſe of India, as there is a conſiderable difference in the ranges yielded by the ſame quantities and qualities of powder, owing, it is probable, to the difference in the denſity of the air.

DIRECTIONS relative to LIGHT FIELD-PIECES on Service.

The wheels of guns and waggons are to be taken off after a march. The axletrees are to be greaſed, and repairs, if wanted, to be given.

The wheels and axles are to be examined once in ten days; and when the guns are at reſt, the naves of the wheels muſt be covered, to prevent the heat of the ſun from affecting them.

The cap-ſquares muſt always be kept well ſecured by the eye-bolt keys.

The elevation ſcrews muſt be always kept working eaſily, by being well oiled. To prevent bending, they ſhould never be ſcrewed higher than half up the braſs box.

The ſhoes under the trail muſt be occaſionally examined, being apt to become thin from uſe.

The hole in the trail-tranſom, and the pintail, ſhould be greaſed previous to marching.

If, on the march, the different tackles and ropes get wet, they muſt be well dried before they are put in the lockers.

The tarpaulins muſt be occaſionally tarred, and the ſide-arm ſtraps oiled from time to time.

The man harneſs and ſpare dragropes muſt be laſhed, ſo as not to drag along the ground.

After a march, or field-day, the gun and empty cylinder muſt be well waſhed. The gun muſt be depreſſed, or laid under metal, after being waſhed.

When

When the quantity of ammunition with the gun is ſmall, it may be put into the limber box.

The haſps of the limber boxes are to be towards the horſe; and the boxes ſhould be ſo placed as to counteract, as much as poſſible, the weight of the trail of the gun.

The tow ſhould be put looſely and ſlightly round ammunition packed in the boxes, that it may, with eaſe, be taken off when the ſhot is wanted.

The elevation ſcrew ſhould be covered over with flannel, in marching, in order that it may not be clogged by mud.

The men muſt be ſtationed at the gun according to their reſpective abilities.

Care muſt be taken that the punches are well fitted to the ſize of the vents.

A hammer, a ſpike, and a punch, muſt always be kept in the gun locker.

The ſpunges muſt be kept well coated, ſo as to ſpunge out the bottom of the empty cylinder well.

The axletrees of the gun muſt be kept in a line with the front rank, that the artillery men may not be wounded by the fire of the infantry.

The guns muſt always be brought up to the ſame ground, to prevent their ſhaking the troop by their exploſion.

Before the infantry commences firing, the gun may advance two paces, in order to fire obliquely on the enemy's line. They will afterwards fall into their proper intervals.

The utmoſt care muſt be uſed to prevent hurry, always too apt to produce confuſion.

Previous to action, the officer muſt examine his gun, and try if the vent is clean *.

When the enemy is forming behind a hill, round ſhot ſhould be thrown among them, with a ſmall quantity of powder, and a great elevation.

As

* Two guns were uſeleſs at the battle of Minden, by not attending to theſe matters.

As he advances, round ſhot may be fired obliquely at his ranks, ricochet, or making them hop once or twice before they take the line.

From 600 to 350 yards, round ſhot may be fired, at one degree, or rather more, of elevation, reduced gradually to half a degree, or leſs, if the gun is hot.

Caſe-ſhot, fired at the centre of the line, muſt now be fired.

The gun muſt be loaded in a regular and uniform manner, and the wads muſt be rammed with equal force. A neglect in this point produces great irregularity of effect, particularly when the guns are depreſſed.

In very quick firing, few of the ſhot tell; the gun being worked with too much precipitation, regularity of loading and laying will not be attended to.

The frequency of firing ſhould be regulated by the certainty of doing execution.

When, however, grape is uſed, with a round over it, againſt an enemy very near, the quickeſt poſſible firing may take place.

In this caſe, time muſt be afforded to the detachment to have recourſe to their pikes, to meet the charge.

Caſe-ſhot, at the diſtance of 170 yards, when double loaded, has a decided ſuperiority, in effect, over muſketry. At this diſtance, 1-8th part of the ſhot is found to have effect.

The balls of caſe-ſhot ſhould be ranged regularly, as they will then diverge leſs.

In firing round ſhot, the gun will be pointed well each time, and the requiſite elevation will be attended to. The inſtrument deſcribed in the end of Part Second of this pamphlet, will be found ſerviceable, and ready for this purpoſe.

Grape-ſhot may be fired as faſt as poſſible, and to prevent accidents, the perſon who ſends home the charge, is to give the word "Ready," on ſtepping back into his poſition.

Every

Every ſhot ſhould be made to tell. When they fly over the heads of the enemy, the conſequence will be, that one party becomes encouraged, and the other diſcouraged.

After diſcharging the gun, it is to be immediately drawn forward to its original poſition, over the recoiled ſpace.

When a gun is to be drawn acroſs a ditch, or up a ſteep hill, the dragropes will be uſed, to aſſiſt the horſe. If the ſides of the ditch are very ſteep, the gun is to be unlimbered, and dragged over the ditch, as directed in deſcribing that uſeful ſpecies of gun-exerciſe.

In firing, the limber is to be poſted at a ſhort diſtance, in the rear of the gun, and the other horſes, in charge of ſteady careful people, will be ſtationed with the ammunition-waggons.

In purſuit, the guns will keep cloſe in the rear of the troops, to be in readineſs to check a rallying enemy, and to give time to the battalion to form in the rear, ready for reacting.

When the gun moves over rough ground, the elevation-ſcrew will be apt to run down, and much time may be loſt in ſcrewing up again. To prevent this, whenever the gun is to move, let the ring at the end of the ſmall chain, fixed to the left cheek of the gun-carriage, be put over one of the projecting handles of the horn-place which works the ſcrew. When firing recommences, the ring is to be ſlipped off.

When guns retreat in the rear of a battalion, they ſhould be loaded, to ſtop the progreſs of the enemy. When, on the contrary, the battalion is between the guns and the enemy, the guns ſhould be diſcharged, to prevent accidents from ariſing. It ſhould be a regulation not to be deviated from, (except in paſſing a bridge or narrow defile), never to advance quick with loaded guns, as the lives of 12 men will be endangered.

In quick firing with grape-ſhot, he who ſpunges muſt give the word "Fire," and is not to ſtep out to reload, till he ſees the exploſion. He muſt ſend his ſpunge well home, and turn it, at leaſt twice, to diſengage any hanging fire.

When the gun is pointed, the perſon pointing will give the word, that he may himſelf be clear of the recoil.

The perſon who is to put in the cartridge, will keep it behind the wheel till he ſees the ſpunge withdrawn.

The perſon ſerving the vent is furniſhed with a thumb-ſtall, having a piece of ſoft thick leather on it. The thumb-ſtall is fitted to his left thumb. It enables him to ſerve the vent cloſely, and to wipe off the drops of burning compoſition reſting, after firing, on the vent-field. The thumb-ſtale is to be damped from time to time.

The perſon who brings the cartridge from the cartouch, will carry it on the left ſide, under his coat, till he delivers it to him who puts it into the piece.

The perſon who fires, holds his portfire under the centre tranſom, and when he fires, he is not to raiſe his hand with a wide circular movement, but on the ſhorteſt line poſſible, leading to the tube in the vent.

The perſon ſerving the vent will not withdraw his thumb, till he ſees numbers 7 and 8 clear of the gun in their reſpective poſitions.

Thoſe who carry the cartouches will be careful in keeping them ſhut, and will carry the ſpare portfires in their hands.

The dragropes are never to be fixed in firing, leſt the recoil ſhould drag down the men, and hurt them.

It ſhould be remembered, that a ſmall gun will recoil, on even ground, above 7 feet.

He who is in charge of the ſpare portfire-ſtick, will always have a portfire ready fixed in it.

The

The portfire is to be lighted under the traverſing hand-ſpike, and is not to be handed, lighted, acroſs the cheeks, leſt it ſhould blow up the tube-box.

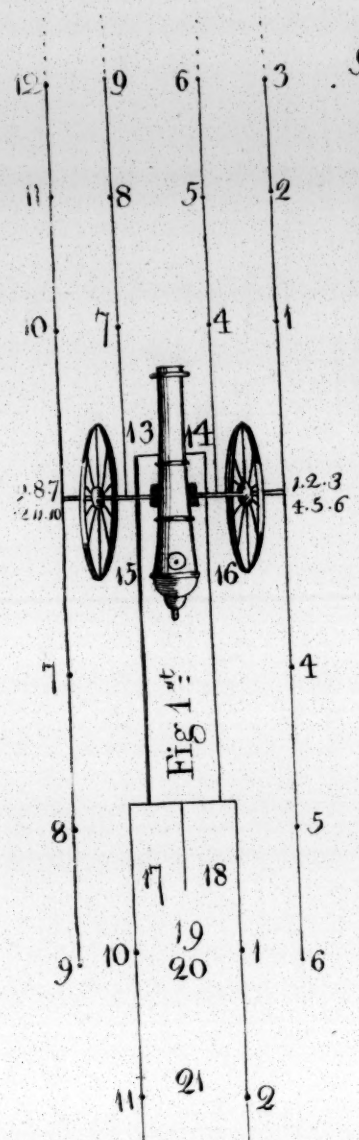
The ſpunge muſt be wetted often, and after half a dozen of ſhots, the wadhook ſhould be introduced, to clear out any bottoms of cartridges that may have lodged in the cylinder.

If a tube ſtick in the vent, the perſon who tubes muſt immediately ſay, " Ceaſe loading, a tube ſticks."

The punch, for clearing the vent, and hammer, ſhould be attached by a ſtring, that they may be ready together when wanted.

Should the gun go off before the perſon who tubes has time to ſtep clear of the wheel, he muſt inſtantly throw himſelf acroſs the locker-board.

FINIS.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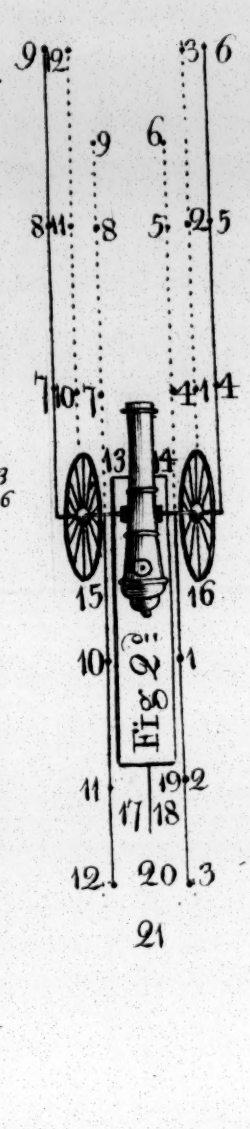
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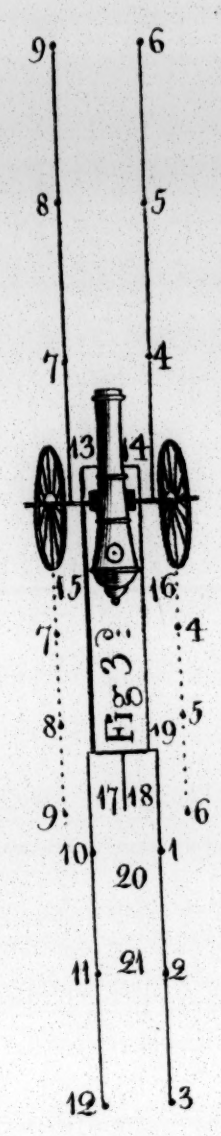
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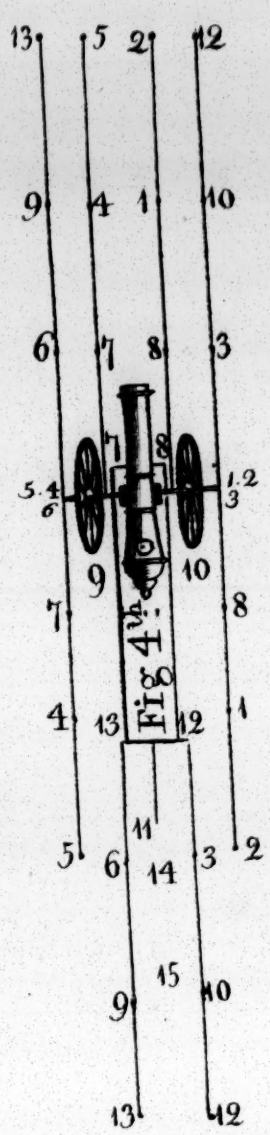
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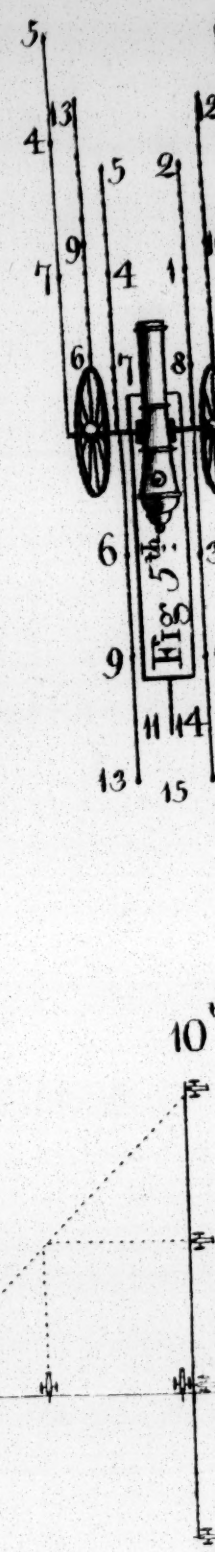
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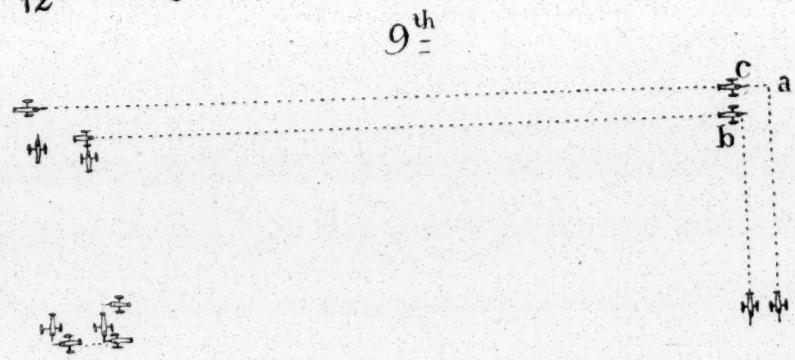
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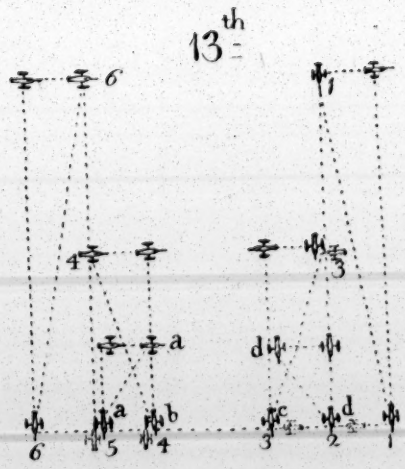
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14th
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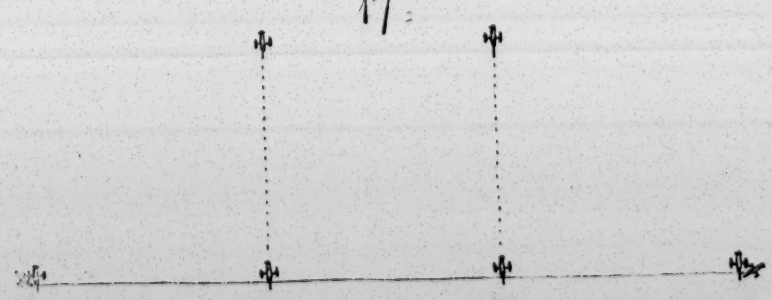
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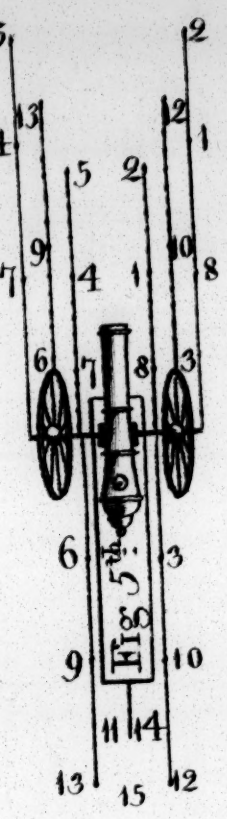
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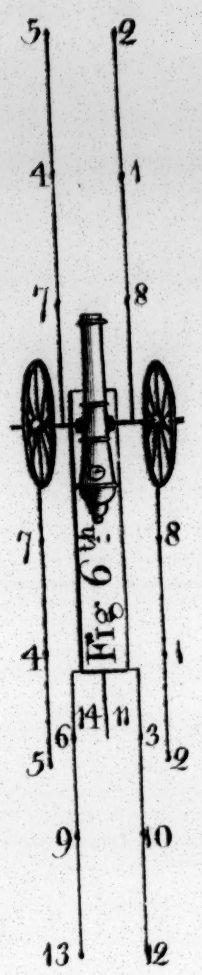
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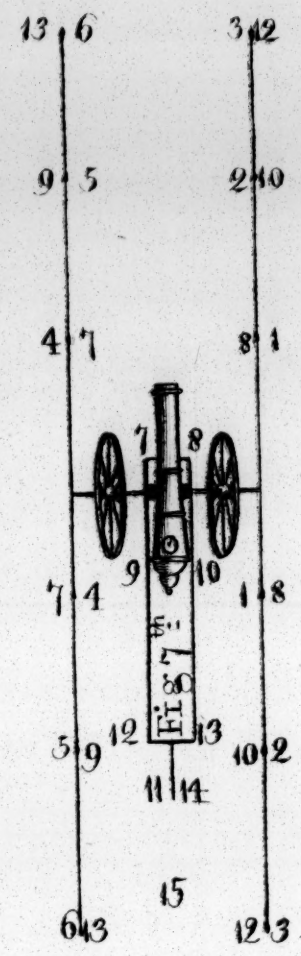
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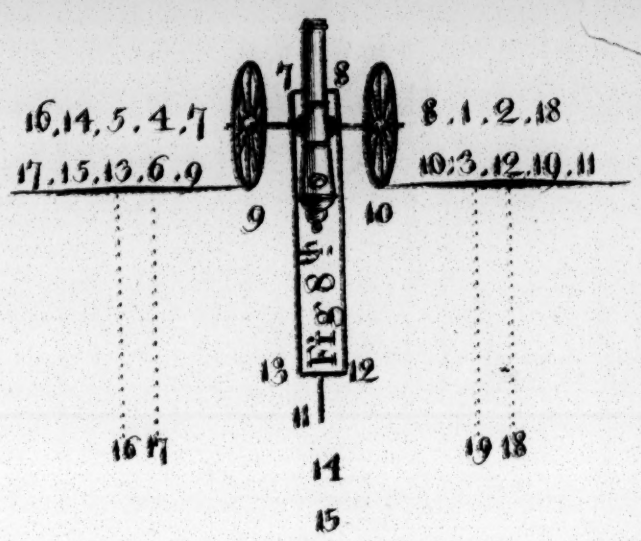
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8,1,2,18
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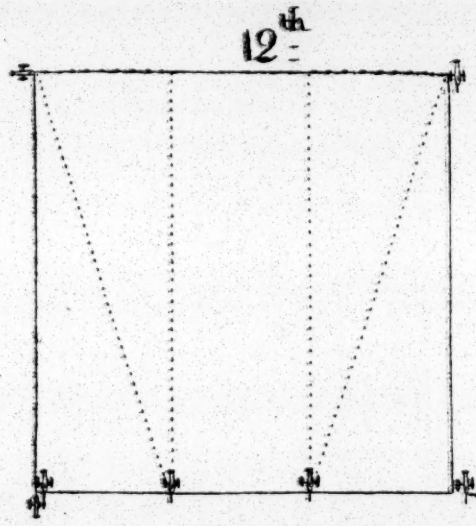
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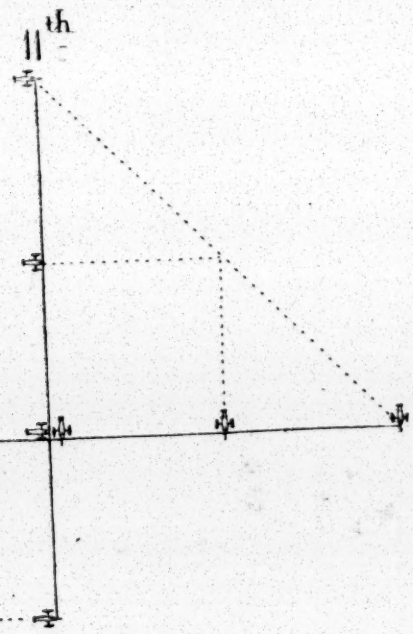
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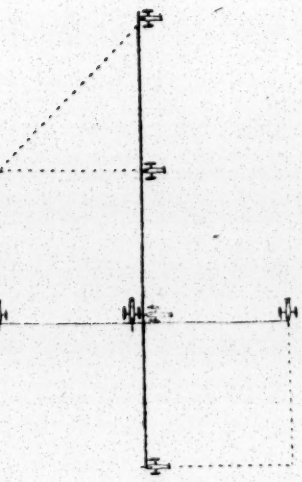
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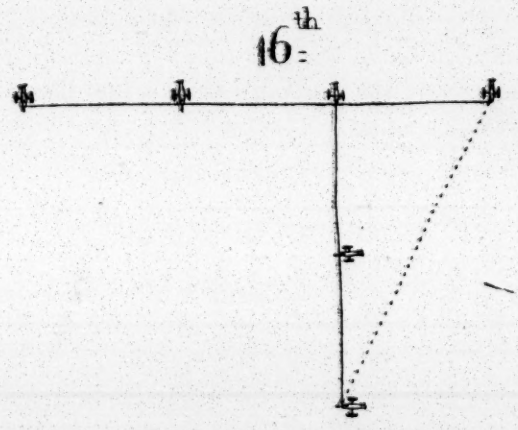
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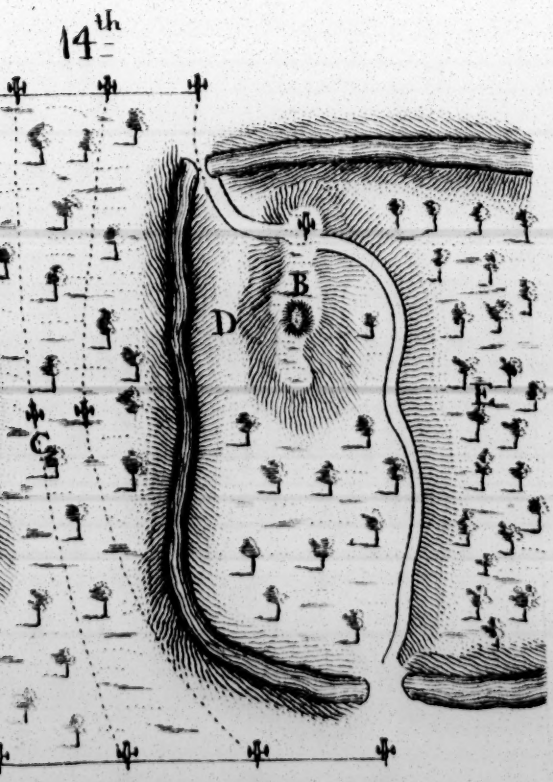
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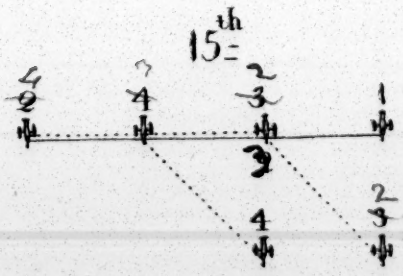
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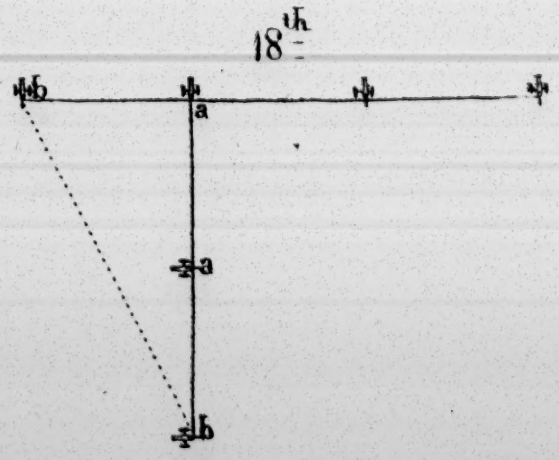
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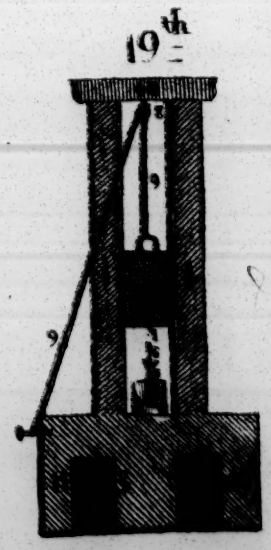
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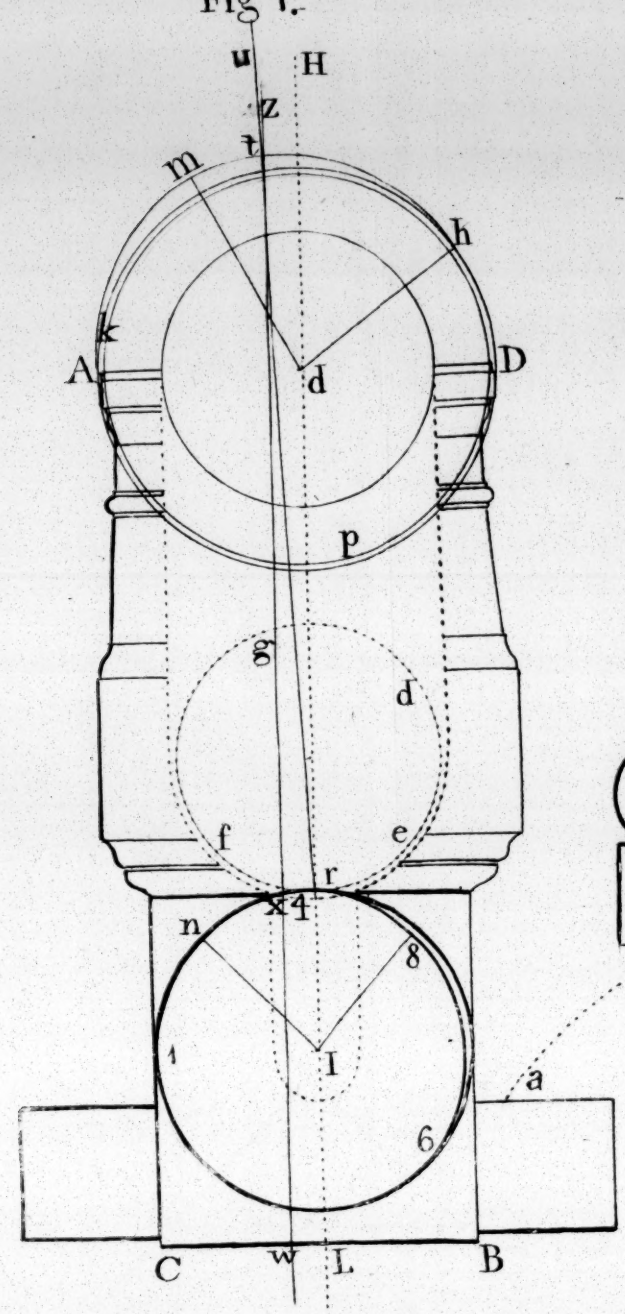

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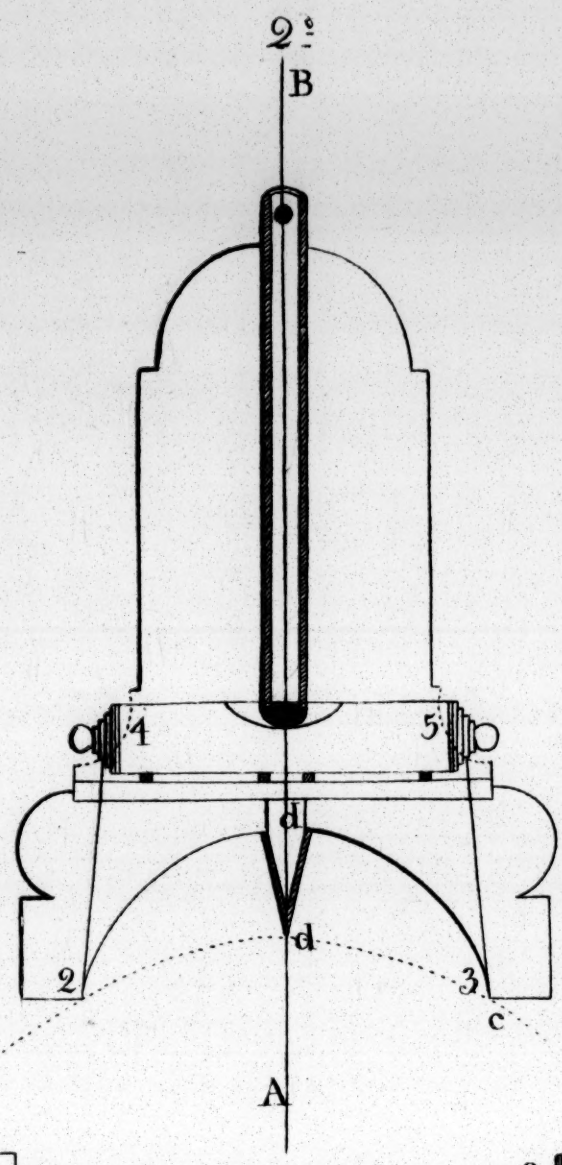

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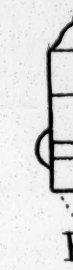

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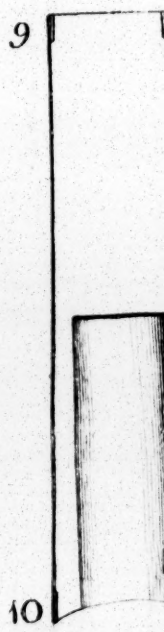

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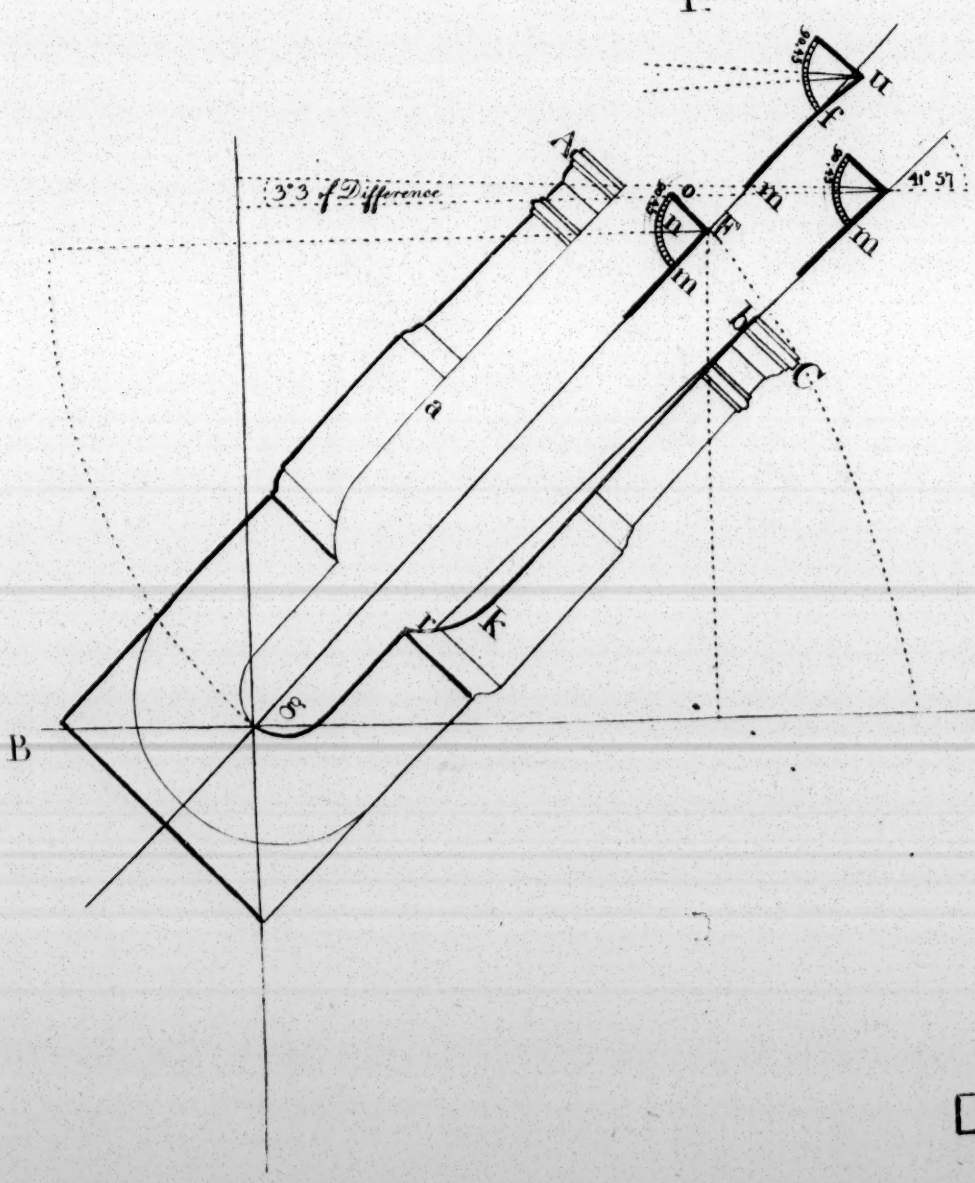

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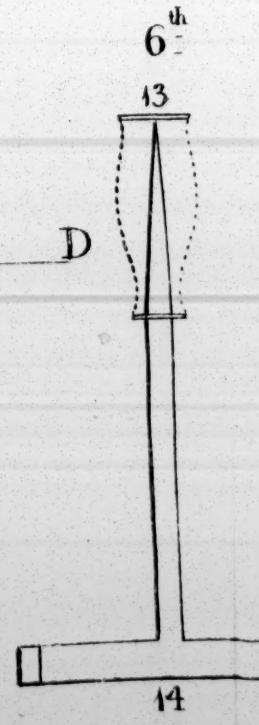

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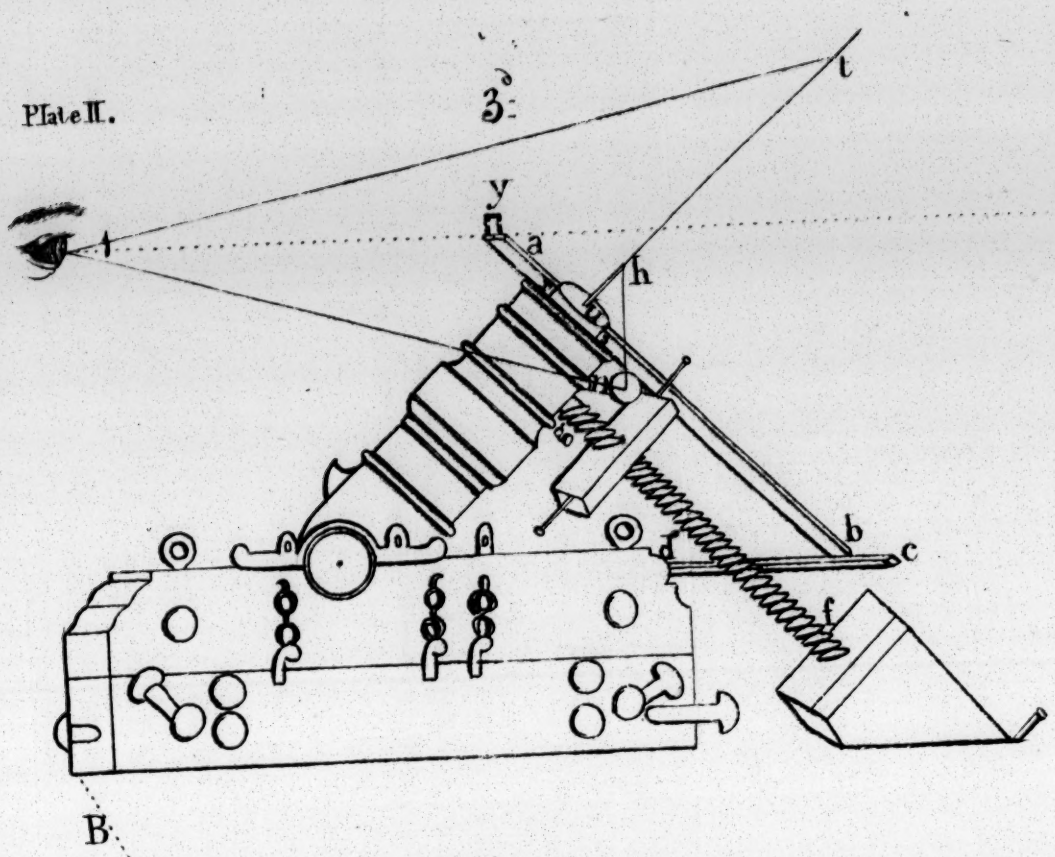

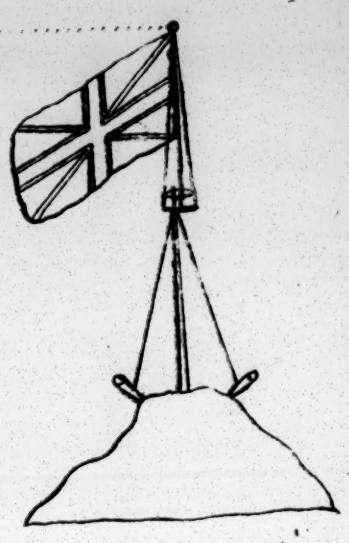

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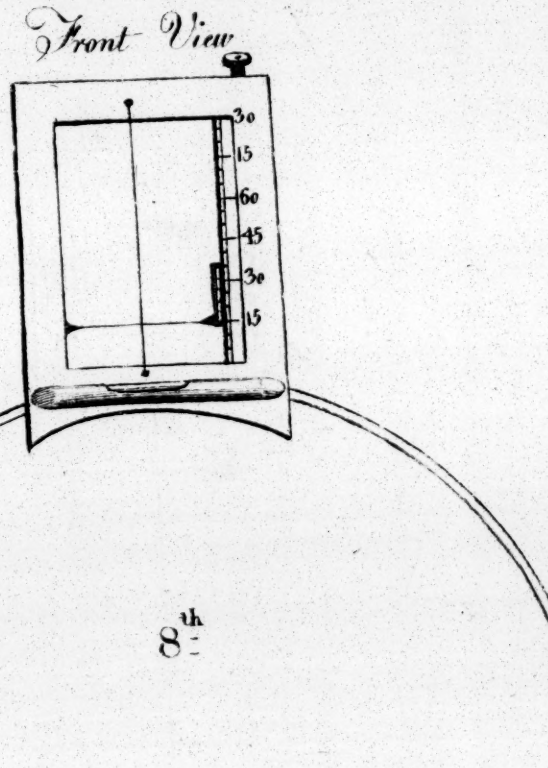

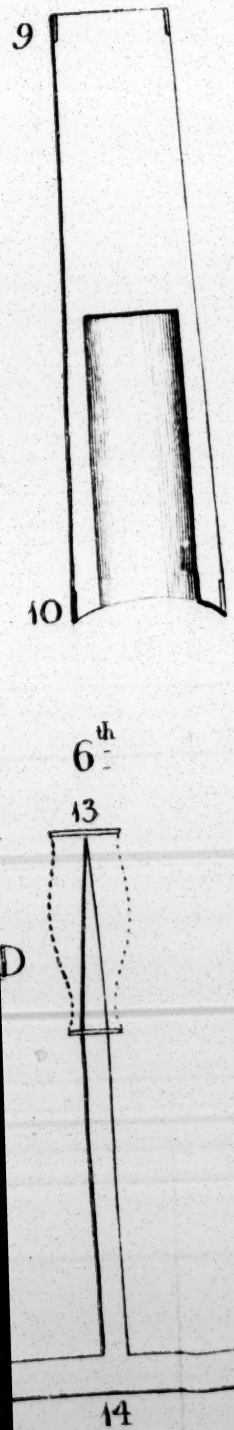

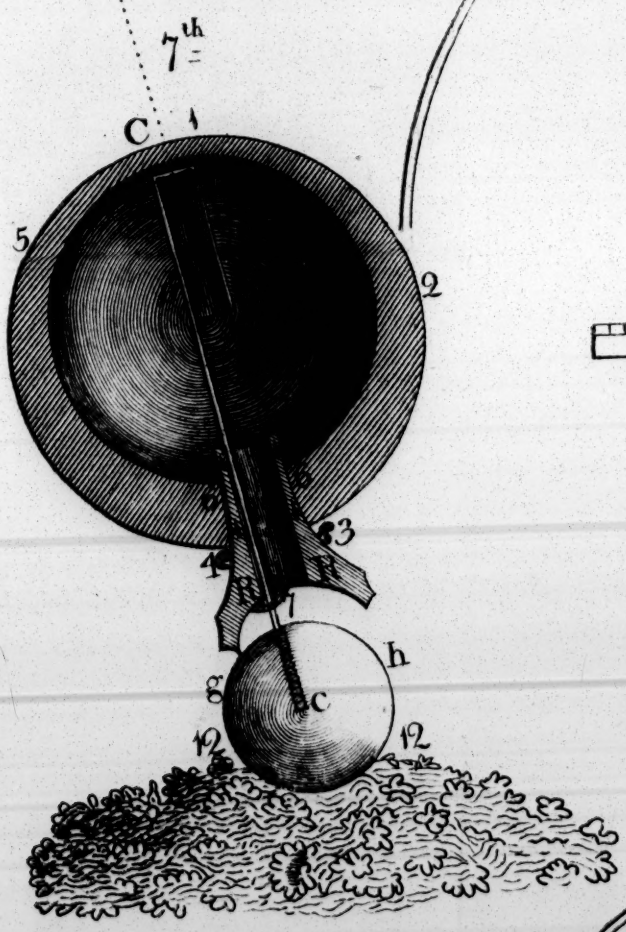

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